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EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall, Manager.

CHARLES W. PRICE.....Editor-in-Chief
A. A. GRAY.....Managing Editor
MORTON GITHENS LLOYD.....Technical Editor
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EVIDENCE BEFORE PUBLIC-UTILITY COMMISSIONS.

The increasing development of the practice of corporate regulation by public-utility commissions is introducing many important problems for the consideration of central-station, electric-railway and telephone company managements. In order that all such companies shall make the best possible showing when appearing before these state tribunals, it is necessary for those representing an operating organization to prepare complete evidence upon the cases in hand, for more and more it is apparent to close observers of regulation that the most minute information is certain to be demanded from the public-service corporations which are parties to commission business. In other words, the administrative, legal and technical branches of a central-station organization, must work together to face an even greater range of inquiry than is customary in the courts, since the commissions everywhere are seeking the fullest possible information upon all phases of operation which in any way are related to questions of investment, running costs and rates charged for service.

There is nothing about this thoroughness of inquiry which need alarm the most conservative management, for only upon the basis of complete information is it possible to reach a fair decision in the complex issues involved in petitions for franchise grants and renewals, changes in existing rates, and issues of capital. There is not the slightest question that the great majority of public-utility companies in this country are doing their utmost to conduct their business upon fair and honorable lines; and where this is so, the most acute cross-examinations by opposing interests cannot injure the corporate standing in the eyes of the commissions, provided every facility is accorded such boards to secure the fullest possible range of information. The presentation of evidence before such a tribunal becomes, therefore, a matter of supreme importance.

In a rate case, for example, a thorough inquiry calls for the presentation of exhaustive evidence concerning the prices paid for apparatus and materials used in construction, provided the commission is disposed to give full weight to the magnitude of the existing investment and any probable depreciation upon it. It must do this to reach a fair conclusion, but not seldom the lack of adequate records of equipment prices, and life experienced under service conditions,

hampers the company. It is surprising how far back an inquiry may be pushed in connection, for example, with the installation of underground-conduit lines and cables, requiring the presentation of at least transcripts of record books showing the amount of ducts and wire laid in annual quantities, running back perhaps ten to twenty years. The importance of keeping old vouchers of construction cost has frequently appeared in the conduct of hearings of this kind, since the aim of outside experts and counsel for those attacking an existing schedule of rates is almost invariably to show that the cost of the work done in former years was excessive, or else that modern methods would enable a given installation to be made with a reduced investment. In most cases the parties attacking rates or contending against an issue of stock at a given price are willing to admit the justice of a reasonable return upon the money actually put into the work, plus an allowance for operation, maintenance, taxes, insurance and depreciation. The depreciation allowance is invariably subject to more or less discussion; but behind this lies the necessity of reaching an agreement concerning the actual investment in the property.

Evidence prepared for presentation before a public-utility board must include the possibility of being followed to its initial basis, if it is to certainly withstand the assaults of opponents. It cannot be too much emphasized that the production of actual cost records from the company's archives is the best answer to the estimates of outsiders as to the cost of doing a given piece of work. Even if the experts of the petitioner seeking a rate reduction are permitted to make a careful appraisal of the company's plant and property, such figures are in the last analysis inferior to actual records of money spent for labor and materials on the job itself. It is simply a case of balancing facts against opinions, and to do this successfully against the distinguished experts sometimes called into service by municipalities or groups of consumers against the company, requires systematic accounting for every dollar spent in the company's conduct of affairs. It is not necessary to be disturbed over cross-questioning which is merely speculative in character.

If it is important to maintain careful records of installation costs, it is equally so to register in some permanent form the dates of installation, repairs of importance and replacements of individual pieces of machinery by new equipment. All the theories in the world regarding depreciation must give place to actual facts concerning the effective life of apparatus drawn from the permanent records of the company, no matter whether the equipment is worn out or replaced on account of obsolescence. And in this connection the company which presents evidence upon operating policies must be prepared to introduce to the commission the men actually doing the work in the field, if the cross-fire of opponents is to be most effectually combatted.

Finally, it will pay the public-utility manager to spend time once in awhile in reading over the stenographic testimony of cases before different tribunals of the regulating type, if he is within reach of such evidence, for within such pages are inevitably compressed the fruits of a wide operating and administrative experience with the additional benefit of an actual exhibit of the way in which cases have been handled in the past.

ELECTRICITY IN MINING.

An announcement will be found upon another page of a prize which has been offered in England for an electric miner's lamp which will meet certain requirements as to safety, portability and general suitability. There are outfits already on the market consisting of a small portable storage battery connected to a high-efficiency incandescent lamp, but these do not seem to have met all the requirements of mine work. Neither are the old-fashioned oil "safety" lamps entirely satisfactory under all conditions, and explosions have occasionally been caused by them. It is to the electric lamp that miners are looking for a final solution of their problem.

It should not be so very difficult to meet the requirements laid down by the Secretary of State for Home Affairs, and the opportunity should meet with a response from American inventors. While the prize offered, $4,860, is not a large sum, and might not pay for the development work, the principal reward would come from the commercial possibilities to the successful competitor after the award is made. For a moderately priced lamp meeting all the conditions, the demand would be enormous, both in England and this country.

The applications of electricity in mining are being steadily extended. The first use of it to be made was for propelling cars of coal or ore to the mouth of the mine through horizontal gangways; later it was used for hoisting in vertical shafts, and also for pumping, drilling, cutting and lighting. It is in collieries that difficulties have chiefly been met. Fire-damp and explosive mixtures of coal dust have made it imperative that all danger of sparking from commutators, switches, short-circuits, etc., be eliminated and that electric lamps be protected from breakage or other dangers. The advent of flame-proof and water-proof motors has marked a distinct advance, and puts direct-current apparatus on an equal footing with alternating-current equipment, which has heretofore been favored. Insulation is receiving better attention than formerly, and on account of the damp conditions which usually prevail it is a very important item.

Electric drive for mining machinery has the advantage over compressed air of a less loss in transmission as well as greater efficiency in application. The conditions of transmission for compressed air in a mine are not the best and the losses amount to two or three times those incident to electric transmission of power.

GAS LIGHTING AT ITS BEST.

While aiding the contract departments and solicitors of electric light and power companies by a continual variety of articles on up-to-date ways of using electric current and of interesting new customers, we have not overlooked the fact that the successful salesman must know his competitor's goods as well as his own. In the case of gas, its general shortcomings have been so evident and so little has been done during recent years in developing new devices or methods that not much space has been needed to show the status of the gas competition.

However, the past year has seen a strenuous effort on the part of the gas company at Chicago to equip its new twenty-one-story office building with gas instead of adopting electric lights, as has been done by all other notable buildings in that city. To do this with any hope of success, meant a departure from the time-honored gas fixtures which had been so easily crowded out of other buildings by more modern types of electric-light fixtures. The results, as set forth before the Illuminating Engineering Society by Mr. Charles A. Luther, show a decided advance over the gas-lighting practice with which we have long been familiar, and probably represent the highest point yet reached in American gas-light practice. It is therefore important for the electrical fraternity to be familiar not only with the new features introduced in the lighting of the building, but more particularly with the real measure of progress and shortcomings which these imply. To aid in this, we are presenting on another page a dozen conclusions which a keen observer has drawn from this, the *ne plus ultra* of all recent gas-light installations.

THE DANGER OF ISOLATED GAS LIGHTING.

It seems strange that with the constantly increasing knowledge of the advantages of electricity, and the widening of the territory reached by the network of transmission lines, there should be much demand for gas or oil illuminants which are stored in or near the house of the consumer, and are in themselves dangerous. Yet this is true, and the newspapers record repeated instances where a too trusting householder hunted with a match for a leak in his acetylene or gasoline plant, with disastrous results.

One item recently appearing in a newspaper describes the explosion of an acetylene church-lighting installation which occurred in a Tennessee town. The plant ceased, during services, to operate, and the pastor, according to the *modus operandi* in vogue on such occasions, sought the cause of the trouble with a lighted match. An explosion resulted. This village was of about 3,500 population and had an electric light plant giving both night and day service.

A similar accident happened within a very few miles of a city of 20,000 population, and well within the radius of the city's distribution lines. In this case the owner of a recently installed gasoline illuminating plant detected the odor of gasoline and sought with a match to find the leak. The house was completely destroyed as a result of the explosion; the man himself was seriously injured and a little girl on the scene was killed.

That such cases as this appear frequently among the news items of our daily papers, indicate that there must be a large amount of business yet obtainable from people who have passed the oil-lamp stage and are searching for some better illuminant. It is in this line that "missionary work" is needed from the central stations, and in this direction the lighting business will find much growth.

The attention of the consumer should be called to the danger of private illuminating plants, and it is necessary through judicious publicity and advertising matter to keep the public informed of the cleanliness, safety and convenience of electric lighting and power. Although it may seem incredible it is nevertheless a fact that acetylene and gasoline lighting have, in some small and even moderate-sized towns, been allowed to gain a foothold through nothing less than a laxity in the management of the local central station. The solution of the question will be found when up-to-date central-station methods become universal and the value of publicity and education is fully realized.

UNDERGROUND CABLE.

The laying of conduits in city streets for the purpose of running electrical conductors underground has become so common in this country that one is likely to look upon this as the only approved method of running cables under the surface. And in city streets, where the surface is paved and where the street may be torn up again at any time for other purposes, this does seem to be the only satisfactory method, although the forms of available conduit construction are numerous. But in parks, suburbs and open country, where the above conditions do not have to be met, the construction of a conduit seems to be superfluous, especially where a single cable is to be run.

An alternative plan is to run cable loose in the ground, burying it to only a depth sufficient to give protection from any disturbance at the surface. The cable covering must be, of course, waterproof and sufficiently rugged to withstand ordinary handling. These requirements are no more than are met in conduit work, and similar lead-covered cable is frequently used without conduit. Where greater protection seems necessary, armored cable may be used, or what is just as cheap, the lead-covered cable may be run in iron pipe. In the latter case, it need be only barely covered with earth, sufficient to protect it from unusually rough knocks.

Cable has been run in this manner in the outlying portions of Philadelphia, New York, Washington and other cities; and has proven very satisfactory for suburban and rural lines. In Europe it is more widely used; indeed, conduits are resorted to only when they are unavoidable, as conduit construction is not at all popular on the Continent.

Boston Edison Company Opens Electric-Vehicle Garage.

The activities of the Boston Edison Company relative to electric-vehicle matters have received widespread attention and the remarkable results that are being attained in the permanent establishment of the electric in Boston bear out the contentions of electric-vehicle enthusiasts that central-station co-operation is a dominant feature in the advancement of the business.

Perhaps one of the most significant steps taken by the Boston Company in this campaign was the establishment of an electric-vehicle garage on Atlantic Avenue in the heart of the city. The location is an ideal one and the building is devoted exclusively to electrics. Within a short time after the announcement was made that such a building was being prepared, there were many vehicles booked, and before it was opened about all the space had been engaged by owners of all types of commercial vehicles.

In fitting up the building no attempt was made toward artistic effect, but every effort was exerted to provide means for the best of service in the simplest manner possible, one desire being to prove to prospective garage owners the inexpensive manner in which a model garage can be provided without sacrificing quality of service or the convenience of the public.

The portion of the building fitted for this purpose covers an area approximately 100 feet by 50 feet, with a roof clearance averaging about thirty feet, and it is estimated that this space will accommodate between twenty and thirty vehicles.

The current for charging is obtained from the Edison Company's direct-current three-wire mains, and is conducted to two charging panels located in the operating room on the northeast corner of the building. Each panel has mounted upon its six charging switches, instruments and charging rheostats, from which the current is carried to charging receptacles conveniently located about the charging area. Sufficient space has been reserved for additional equipment when required. Charging plugs with sufficient lengths of cable are provided to accommodate vehicles in any part of the building.

The floor consists of a smooth concrete surface, and the entrance is of sufficient size to admit the largest truck when fully loaded. The washstand, repair shop and battery space are located at one end of the building, while at the other are facilities for charging sparking batteries and the work bench, with a full equipment of modern tools for light repair work.

The office, located in one corner of the room, is comfortably fitted for the convenience of operators, and provision is made for the keeping of operating and maintenance data in detail, so that exact costs of all description can be figured out for the customer's information, or for commercial comparisons.

A gallery at the farther end comprises the stock room, where supplies and spare parts are stored; also the drivers' quarters, provided with lockers, table and chairs for their convenience. The entire building is lighted with Mazda lamps equipped with Holophane reflectors, so spaced as to give adequate illumination at a minimum expense.

It is the plan of the company to offer its garage services at a flat rate per vehicle per month, this service to include electric charging, irrespective of mileage, washing, flushing, battery testing, inspections, polishing, expert advice, adjustments and minor repairs. Spare vehicles are available at the garage for towing home cars in case of accident or failure of power, at reasonable rates and for rental when machines are laid up for painting or repairs. The company expects to have its garage taxed to the utmost.

Railway Signal Association.

The Railway Signal Association held a meeting in New York City on June 13 and 14 at the Hotel Astor. The attendance was large and representative. Reports of twelve committees were received and passed upon for presentation at the annual meeting to be held in Colorado Springs next October.

C. E. Denney, of Cleveland, president of the Association, was present and presided at the sessions. Among the papers read was an interesting one on "Apparatus for Charging Storage Batteries," by H. K. Ferguson, R. E. Russell and E. E. Kimball.

Among those in attendance were C. C. Rosenberg, of Bethlehem, Pa., secretary; C. C. Anthony, of Philadelphia, vice-president; B. H. Mann, of St. Louis; W. L. Candee, of the Okonite Company, New York; Azel Ames, of the Kerite Company; Charles E. Grown, Central Electric Company, Chicago.

A banquet and theater party were given to a number of the members by Captain Candee on Tuesday night.

The Association has a membership of about 300, composed largely of active, progressive, young men.

Postal Telegraph to Undertake Telephony.

Announcement was made on June 12 at the executive offices of the Postal Telegraph Company, in New York City, that it is to enter the telephone field. As a result of experiments that have just been completed between Salt Lake City, Utah, and Reno, Nev., and between Reno and San Francisco, its trunk telegraph lines are to be used for telephone messages between those cities.

National Gas and Gasoline Engine Trades Association.

The National Gas and Gasoline Engine Trades Association will meet June 20 to 23, inclusive, at the Hotel Pontchartrain, Detroit. At the opening session, Tuesday morning, there will be the usual preliminaries in the way of announcements, reports of officers and short talks of about five minutes by various members.

The afternoon session and remaining days will be devoted to reading of papers, reports of committees, excursions, etc. Friday will be devoted to trips to engine, automobile and other factories in Detroit. Exhibits will be arranged in rooms adjoining the meeting hall.

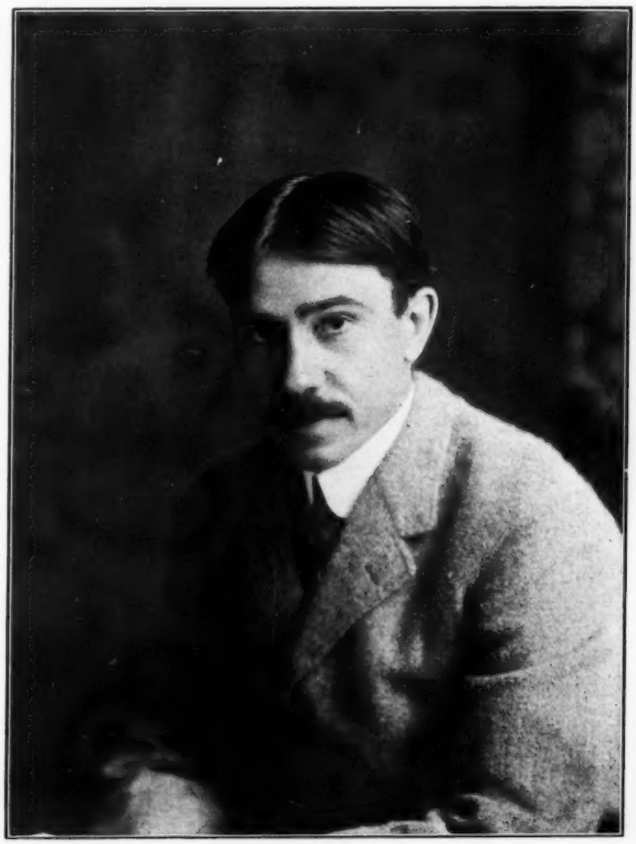
Everyone interested in this field is invited to attend the meetings whether a member or not. Special invitation is extended to all who expect to be at the convention to bring their ladies with them. A special train will run from Chicago via Michigan Central Railroad, leaving Chicago at midnight June 19.

Chicago Electric Club.

Sidney A. Teller addressed the Chicago Electric Club on June 14, calling attention to the work the City of Chicago is doing in establishing small parks in the various congested districts. He pointed out the advantages of these parks both as a children's playground and as a social center for the surrounding inhabitants. He cited statistics showing the good they accomplish and pointed out the urgent need for more of them.

Ralph D. Mershon.

Ralph Davenport Mershon, engineer and inventor, was born in Zanesville, Ohio, July 14, 1868, son of Ralph Smith and Mary (Jones) Mershon. He was educated in the public schools of his native place, and began his engineering career at the age of seventeen, as a member of an engineering corps engaged in railway location and construction. In 1886 he entered the Ohio State University, from which institution he graduated in 1890, with the degree of Mechanical Engineer. During the last year of his university course, he was student assitant of physics and electrical engineering, and for one year after graduation (1890-91) he was assistant instructor of electrical engineering. During 1891-1900, he was employed by the Westinghouse Electric & Manufacturing Company of Pittsburg. While with this company, Mr. Mershon had experience in all branches of electrical work; research work, both theoretical and practical; experimental work; designing; factory engineering; field engineering and installation; patent expert work and patent experimental work; commercial work and selling. He designed the transformers for which the Westinghouse Company received an award at the World's Columbian Exposition at Chicago in 1893.



RALPH D. MERSHON,
Consulting Engineer.

In 1893-95 he had charge of certain work being done by the Westinghouse Company in connection with the extension of the transmission plant of the Telluride Power Transmission Company, of Telluride, Colo., which was a single-phase alternating-current transmission, employing single-phase synchronous motors.

In 1896-97 he carried on at Telluride for the Telluride Power Transmission Company and the Westinghouse Electric & Manufacturing Company an investigation of the phenomena which occur between conductors at high voltages. This investigation was carried out on a transmission line about two and one-half miles long, and was the first investigation ever made in which quantitative measurements were obtained of the ionization and other atmospheric losses occurring between conductors at high voltages. Original methods of investigation were devised by Mr. Mershon for this work, and special apparatus designed and built by him, by means of which quantitative measurements were made up to 72,000 volts. At the completion of the quantitative work, the voltage was carried up to 133,000 volts, at that time by far the highest voltage that had ever been impressed on an outdoor line.

Securing leave of absence from the Westinghouse Company in 1897-1898, he acted as chief engineer of the Colorado Electric Power Company, during the designing and installation of their transmission plant, which generates current by steam at Canon City, Colo., and transmits power at 25,000 volts to Cripple Creek, a distance of twenty-five miles, where it is used for mining.

From 1897 to 1900, Mr. Mershon was engineer of the New York office of the Westinghouse Electric & Manufacturing Company and, during the latter year, he resigned to enter upon private practice as a consulting electrical and mechanical engineer in New York City, with a branch office in Montreal, Canada.

Some of the more important pieces of engineering work accomplished by him since entering practice as a consulting engineer are the reconstruction and enlargement of the water-wheel, generating, transforming and transmitting equipment of the Montreal & St. Lawrence Light & Power Company (now a part of the Montreal Light, Heat & Power Company), transmitting 20,000 horsepower at 25,000 volts to Montreal, a distance of seventeen miles; the design and supervision of the transmission plant of the Shawinigan Water & Power Company, transmitting power at 50,000 volts a distance of eighty-five miles to Montreal; the design and installation of the substation equipments of the Montreal Street Railway Company, having an aggregate capacity of about 12,000 horsepower, for utilizing the power transmitted to Montreal from various hydraulic plants; the design and supervision of the transmission plant of the Niagara, Lockport & Ontario Power Company for transmitting power at 60,000 volts from Niagara Falls to various points in New York State. This latter plant is the largest transmission plant which has ever been undertaken in point of capacity, and is one of the most important in point of distance of transmission. Its present capacity is 60,000 horsepower, and it is laid out for an increase of 180,000 horsepower. Its longest feeder is, at present, 160 miles.

Mr. Mershon has invented and patented a number of devices which are being today manufactured under his patents, amongst the most important of which are the following:

The six-phase rotary converter for converting alternating to direct current. This invention covers the transformation of current from three-phase to six-phase by means of three transformers and feeding to six-phase current into the rotary converter.

The compounded rotary converter, using an artificial reactance in series with the alternating-current side of the

rotary converter. The use of a separate reactance in connection with each rotary enables the compounding effect of the series coils of each machine to be effective upon that machine only, without affecting the other apparatus fed by the same circuit.

A system of lightning protection for electrical apparatus, especially applicable to high-voltage circuits.

A system of protection against the possibility of fire in the case of installations of oil-insulated transformers.

A compensating voltmeter, enabling the indication at any point of a transmission system of the voltage at any other point, without the use of pressure wires. This device taken account of the resistance, reactance, leakage and capacity current of the transmission line and of the power-factor of the load. Mr. Mershon received from the City of Philadelphia the John Scott medal and premium for this device.

In 1905, and for several years subsequent, he was retained on the work of the Victoria Falls Power Company, in connection with the steam stations which they are installing near Johannesburg for supplying power to the gold mines of the Witwatersrand, and in connection with the proposed transmission of power from Victoria Falls on the Zambesi River, Rhodesia, South Africa, to the Rand, for operation in connection with these steam stations.

Mr. Mershon is the author of a number of technical papers, amongst which are "The Output of Polyphase Generators and Rotary Transformers," 1895. This paper contained the first published analysis of the effect upon the output of closed-coil windings, when the number of phases is varied. "Drop in Alternating-Current Lines," 1897, treating of the calculation of drop and giving a table and chart by means of which such calculations can be quickly and accurately made. "The Maximum Distance to Which Power Can be Economically Transmitted," 1904. This paper was presented at the International Electrical Congress at St. Louis, in 1904, and was read before the American Institute of Electrical Engineers the same year. In presenting this paper at the International Electrical Congress, Mr. Mershon represented the American Institute of Electrical Engineers, acting as "Delegate from the American Institute of Electrical Engineers to the International Electrical Congress." "High Voltage Measurements at Niagara," read before the American Institute of Electrical Engineers, June 30, 1908. This paper gives the results of some three years of investigation of the ionization and other atmospheric losses occurring between line conductors at high voltages. The work was a continuation of that previously done at Telluride.

Mr. Mershon is a member of the American Institute of Electrical Engineers, of which he has been a director and vice-president. He is on a number of committees of the Institute. For many years he was chairman of the committee on High-Voltage Transmission, having been the first chairman, and, as such, having created the work of this important committee. He is a member of the United States National Committee of the International Electrotechnical Commission. He is a member of the Inventors Guild, and at the present time is its president. He is also a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Electrochemical Society, the Franklin Institute of Pennsylvania, the Canadian Society of Civil Engineers, the British Institution of Electrical Engineers, the Société Internationale des Électriciens, and a fellow of the American Association for the Advancement of Science. He is a member of the University Club, the Engineers' Club and the Lawyers' Club, of New York, and of the St. James Club, of Montreal.

Prize for a Safe Electric Miner's Lamp.

The British Home Secretary announces that in order to encourage the production of safe and efficient types of electric lamps for miners, a colliery proprietor has placed at his disposal the sum of £1,000 to be offered as a prize for the best lamp or lamps fulfilling certain specified requirements.

The conditions of the competition are as follows:

(1) The competition will be open to persons of any nationality.

(2) It will be in the discretion of the judges to award the whole of the prize for the lamp which they consider to be the best, or to divide the prize, or to make no award if no lamp appears to them to be of sufficient merit.

(3) The lamps must be addressed, care of Mr. C. Rhodes, at the Home Office Testing Station, Rotherham, England, and must reach the testing station not later than December 31, 1911. A spare globe should accompany each lamp.

The requirements which should be fulfilled by any lamps submitted for competition are as follows:

(1) The lamp should be of sound mechanical construction so as to withstand rough usage.

(2) The lamp should be of simple construction, and easy to maintain in good order and repair.

(3) The lamp should be so constructed as to render impossible the ignition of inflammable gas either within or without the lamp.

(4) The lamp battery should be so constructed that any liquid which it may contain cannot be spilled when the lamp is in use, and means should be provided for dealing with any gas which may be generated by the battery.

(5) The materials used and the construction should be such that metals and other parts will not be liable to deterioriation by corrosion as a result of the action of the electrolyte, etc., used in the battery.

(6) The lamp should be effectively locked, so that it cannot be opened without detection.

(7) The lamp should be capable of giving not less than two candlepower continuously for a period of not less than ten hours.

(8) The light should be well distributed outside the lamp. A movable reflector to concentrate or to shield the light may be provided.

In addition to the above requirements regard will be paid to (*a*) the first cost of the lamp, (*b*) the cost of maintenance, (*c*) convenience in handling, and (*d*) the weight of the lamp when charged and ready for use.

Wisconsin Waterpower Law.

A bill has been passed in Wisconsin, repealing all existing waterpower franchises, giving the holders of such franchises the privilege of exchanging them within one year for permits limited to twenty years and conferring authority on the State Railroad Commission to grant such permits and new permits for the development of other water powers.

It also provides for levying an annual license fee ranging from $0.20 to $2.00 on each horsepower developed, the fee to be based on the value of the power.

The Brunot's Island Power Plant.

A Description of the Generating Station of the Pittsburg Railways Company.

BY HARTLEY M. PHELPS.

One of the largest and most modern generating stations of any street-railway system in the United States is the Brunot's Island power plant of the Pittsburg Railways Company, which controls and operates ninety per cent of the street traction in the Greater Pittsburg territory. Every device of the most improved kind in street-railway operation is to be seen here and the works are a revelation in the use of labor-saving machinery. In the entire plant there are scarcely more than a dozen men, five only in the enormous boiler room, where thirty big boilers are installed. All the machinery, dynamos, engines, etc., are self-oiling, and the automatic stokers and self-cleaning grates of the boilers leave little manual work to be done. The investment in this plant exceeds two million dollars.

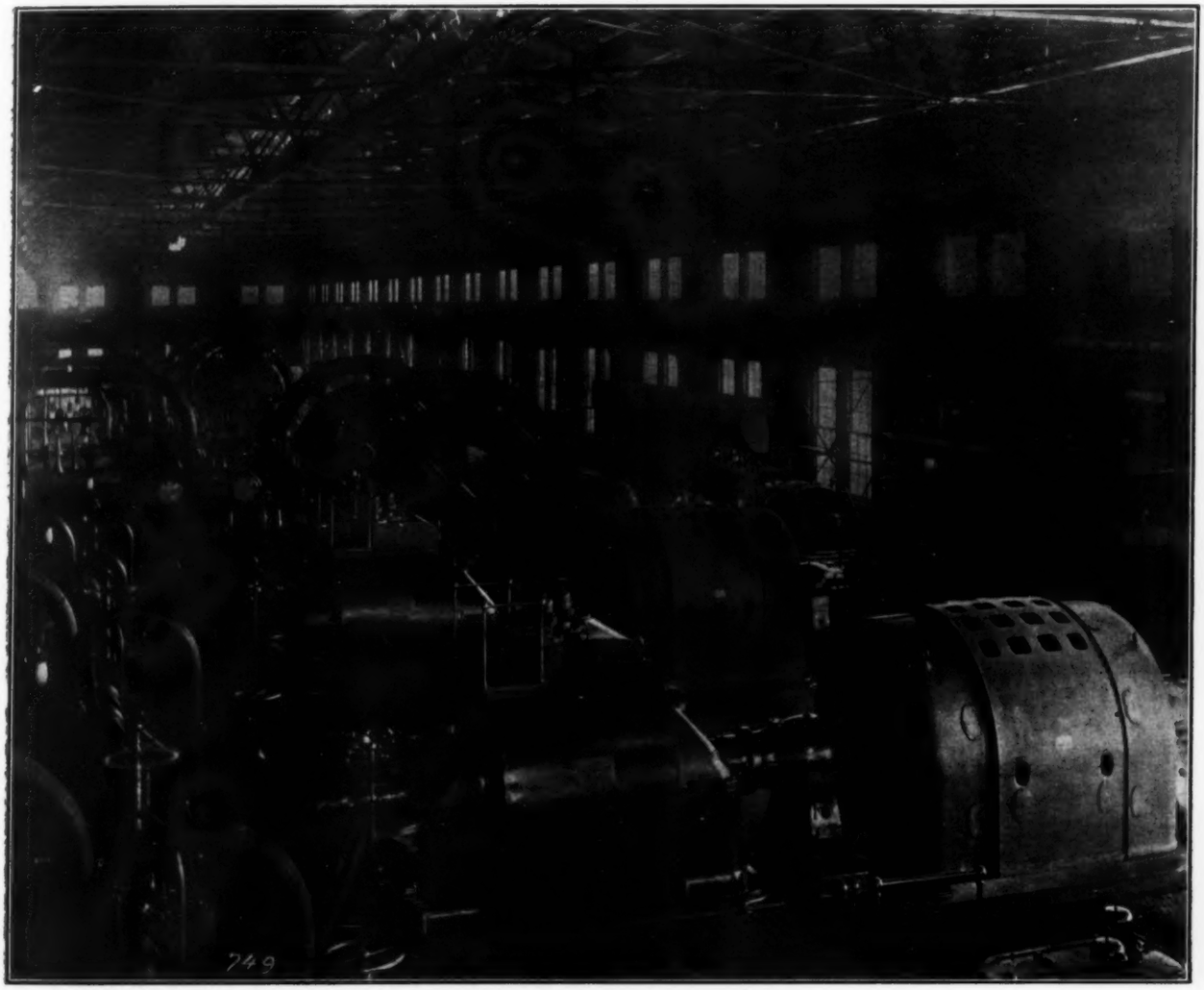


FIG. 1.—VIEW OF GENERATING ROOM.

Brunot's Island lies in the Ohio River about one and one-half miles below the junction of the Allegheny and Monongahela Rivers; its location is particularly well favored for the central generating station of the Pittsburg railway system, as coal and water, the two chief supplies required for operation, may be obtained advantageously. The water is brought into the station through large concrete tunnels connected to intake wells on the river bank, while the coal is unloaded from river barges by means of a clam-shell bucket operated from an engine-driven derrick. This bucket elevates the coal into a large hopper, from which it is loaded into dump cars and conveyed into the boiler room by an electric locomotive. From the dump cars the coal is dumped into chutes leading into the stokers. Coal may also be received by railroad from the Ohio connecting

bridge which spans the island and connects the Pennsylvania Southwest system with the Northwest lines on either side of the river.

The generator room is 600 by 85 feet, with a total capacity of 20,500 kilowatts, equal to about 27,500 horsepower. The power equipment in this room comprises:

Three 1,500-kilowatt direct-current Westinghouse generators, each connected to a cross-compound engine running at ninety revolutions per minute. Electromotive force, 550 volts. Current, 2,727 amperes. These machines, with flywheels twenty feet in diameter, are the largest of their kind in Western Pennsylvania.

Two 1,500-kilowatt alternating-current generators direct-connected to engines as above.

One 3,000-kilowatt alternating-current generator direct-connected to a double-flow Curtis steam turbine running at 1,800 revolutions per minute.

Two 5,000-kilowatt alternating-current generators, each direct-connected to a double-flow turbine running at 1,200 revolutions per minute.

A third 5,000-kilowatt turbine is now being installed and there is space for additional machines in the engine room.

An immense amount of floor space is saved by using the turbines instead of the old reciprocating engines. The 1,500-kilowatt engines occupy 1,130 square feet each; the 3,000-kilowatt turbine only 238 square feet, so it is evident that the turbine, although of twice the capacity, takes up only one-fifth the space. A 600-horsepower boiler occupies about 400 square feet, but to take care of a 1,500-kilowatt engine requires 1,000 square feet, assuming one boiler horsepower were installed for every kilowatt of engine capacity. Thus the boilers take up less floor space than the engine for the same capacity, as is seen in the older type of power house, where the boiler room is usually smaller than the engine room. In the case of the turbine the reverse is true, as the boiler floor space is about 2,000 square feet, eight times the floor space of the turbines.

The switchboard for the control of the equipment is of the most modern type, electrically operated switches being in use. Under the old method of operation it was possible to have all the switches and instruments within reach of the switchboard operator, but this is impracticable in a large capacity station. In the electrically operated switches mentioned a magnet operates the switch, this magnet in turn being controlled by a small switch which can easily be located within reach of the operator.

The switchboard is divided into two parts, one for control of the direct-current machines and the other for the alternating-current machines. The former consists of a board of twenty-four white Italian-marble panels forty-four feet long in all, and on these are mounted the instruments, switches and circuit-breakers for the control of the three direct-current machines and the outgoing feeder circuits, of which there are fourteen of 1,500 amperes capacity each.

The portion of the board for the control of the electrically operated switches consists of a marble-top bench on which are mounted the handles for the operation of the said switches. Adjacent to each handle is a red and a green bullseye, the former, when illuminated, showing that the switch is in, and the latter, when illuminated, that it is out. This desk provides for control of the two 1,500-kilowatt engines, one 3,000-kilowatt turbine, three 5,000-kilowatt turbines and ten outgoing feeders of 4,000 kilowatts capacity each. On the bench is also a dummy busbar showing in miniature the connection of the high-voltage cables in the switch house and above the desk are mounted the meters indicating what is going on in the various circuits.

The outgoing feeders for the direct-current output consist of 600-volt cables. The alternating-current high-tension cables comprise six three-phase cables, feeding the company's substations, also the arc and incandescent-light circuits of the downtown section of Pittsburg and of the East End district of the city. The transformers are six in number, the current being stepped up from 2,200 to 11,000 volts.

The equipment of the boiler-house consists of twenty Babcock & Wilcox boilers of rated capacity of 500 horsepower, each equipped with Murphy automatic stokers and ten Babcock & Wilcox boilers rated at 600 horsepower each, equipped with Roney mechanical stokers. The total boiler capacity at present is 16,000 horsepower. These boilers are also equipped with superheaters capable of raising the temperature of the steam to 100 degrees of su-

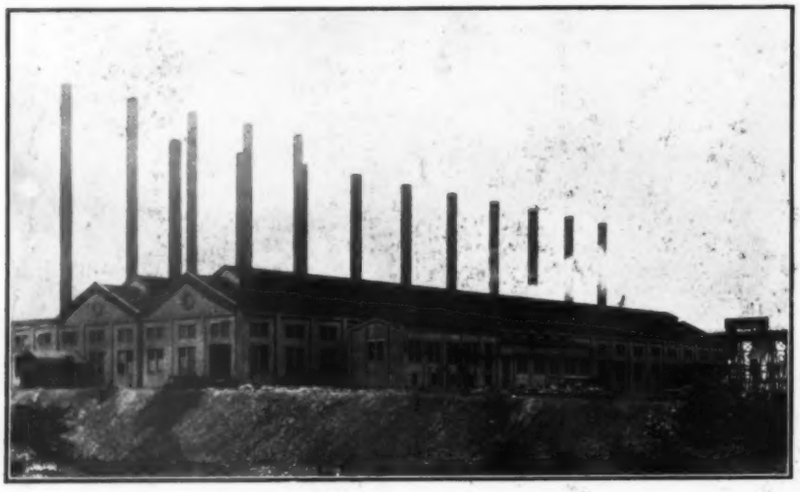


FIG. 2.—BRUNOT'S ISLAND POWER HOUSE.

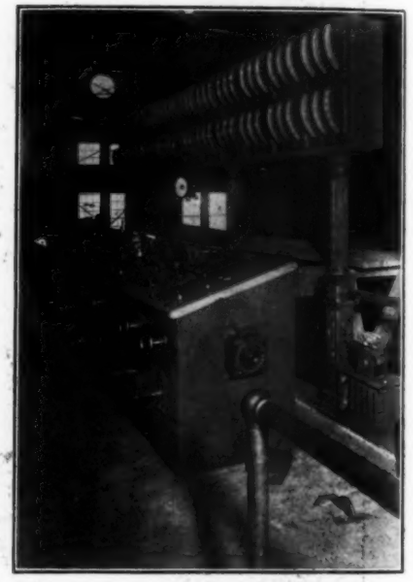


FIG. 3.—SWITCHBOARD.

perheat. There are automatic regulators and water alarms on each boiler.

The first twenty boilers of 500 horsepower each have ten stacks, 150 feet in height. The last ten boilers of 600 horsepower each have five stacks, each towering 175 feet and are seven feet in diameter. In the basement of the generator room are huge Blake condensers and for the engines Altberger condensers.

Cathode Ray Telephotography.

The greatest drawback in connection with telephotography is the inertia of the selenium cell or other photo-electric used in the transmission of luminous impressions. Cathode rays, owing to the instantaneousness of their electromagnetic deflection, allow a telephotographic receiver free from any inertia to be constructed.

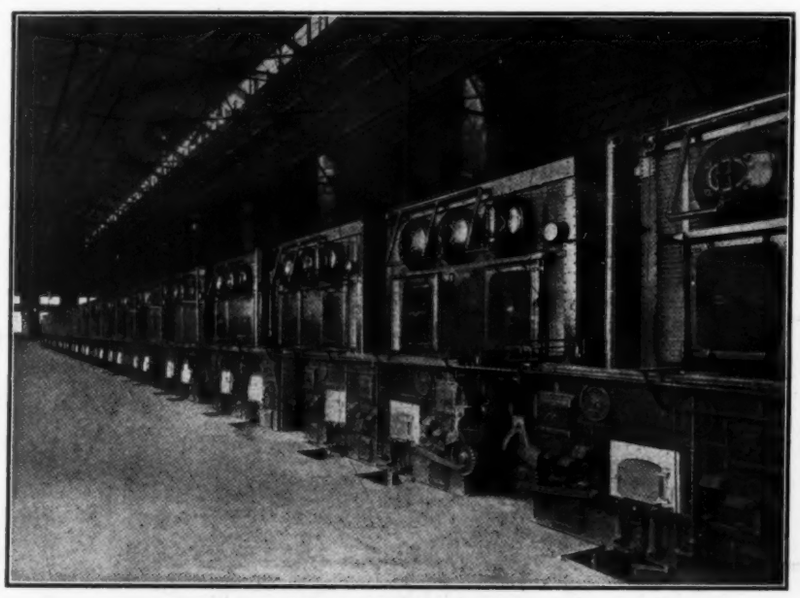


FIG. 4.—BOILER HOUSE.

The following scheme has been recently suggested by two German inventors, in the *Zeitschrift für Schwachstromtechnik*.

A bundle of cathode rays is limited by a diaphragm pierced with a fine hole, through which only a thin pencil of rays is allowed to pass. The style of the transmitter throws into four electromagnets, two current components acting on the beam of light so as to cause it to perform the same movements as the style simultaneously with the latter. The beam of light thus sets up in some convenient substance, such as chalk, a fluorescence producing in the observer's eye the impression of a continual line of light, which comprises the various positions of the luminous point. A few seconds are thus sufficient to reproduce in the receiver any signals or hand-written words. In connection with the transmitter the motion of the style is decomposed into two components converted into current intensities, which expedient has long been used in telautography.

The following modification of the same process is more convenient for practical purposes. A small dynamo connected to a voltage regulator produces currents exciting the electromagnets, so as to cause the beams of light continually to perform a vertical alternate motion, each individual movement entailing a small lateral displacement. In this way the luminous point, in about one second, searches a square of 3 by 3 centimeters. As each luminous impression lasts beyond the actual duration of the impulse, the eye sees a luminous square made up of individual instantaneous impulses.

The transmitter likewise comprises a square of 3 by 3 centimeters, searched in succession by minute metal brushes synchronously with the square of the receiver, the time required for completing the search of the square likewise being of one second only. A battery is connected on one hand to the metal brushes and on the other, through the line to two electromagnetic coils, the working of which is explained in the following:

A small metal pattern destined to be made visible at the receiving station is connected in front of the transmitter square, through the telegraph line, to the other terminals of the electromagnetic coils. Thus the minute brushes will search in succession the various parts of the metal pattern, closing each time the line-current through the electromagnetic coils. The latter accordingly deflect the cathode rays already in front of the diaphragm so as to cause the luminous point on the screen to disappear at each current closure. At each contact between the brushes and the metal pattern at the transmitting station all the spots corresponding to contacts in the transmitter square, thus appear black in the receiver, a silhouette of the pattern appearing on the luminous square.

As the luminous spot, after searching in 0.1 second the whole of nine square centimeters, again begins the same motion, the silhouette of the pattern on the receiver square will follow accurately and continuously any motion performed by the pattern of the transmitter. According to this arrangement 0.0002 second suffices for producing one picture element.

The process above described is the only one in connection with which the time of production of luminous spots can be reduced sufficiently for the first luminous impression not yet to have vanished by the time the whole surface has been searched, thus producing the illusion of a continuous image. Moreover, this is the only method allowing the image at the receiving station to follow any movement of the pattern at the transmitting station instantaneously and synchronously. In order to eliminate any disturbance due to lengthy transmission lines, the inventor intends utilizing electromagnetic waves for the transmission of luminous impressions.—*London Electrical Review.*

Power Sites Withdrawn.

The Government has withdrawn three new power sites during the month of April, comprising an aggregate of 97,889 acres, in line with the policy of first withdrawing such areas as may be considered necessary for the protection and conservation of mineral and water resources.

Electricity on the Rand.

At the last meeting of the South African Association of Engineers, Mr. Dobson, the retiring president, referred to the great advance the use of electricity was making on the Rand. Within a brief period of five years the Witwatersrand had developed on the electrical side beyond the dream of the most imaginative and there was every reason to predict that they were fast approaching an all-electrical period of existence and the names of Hammond, Ayrton, Armstrong, Harper, and others will always be associated with this period of Rand electric development.

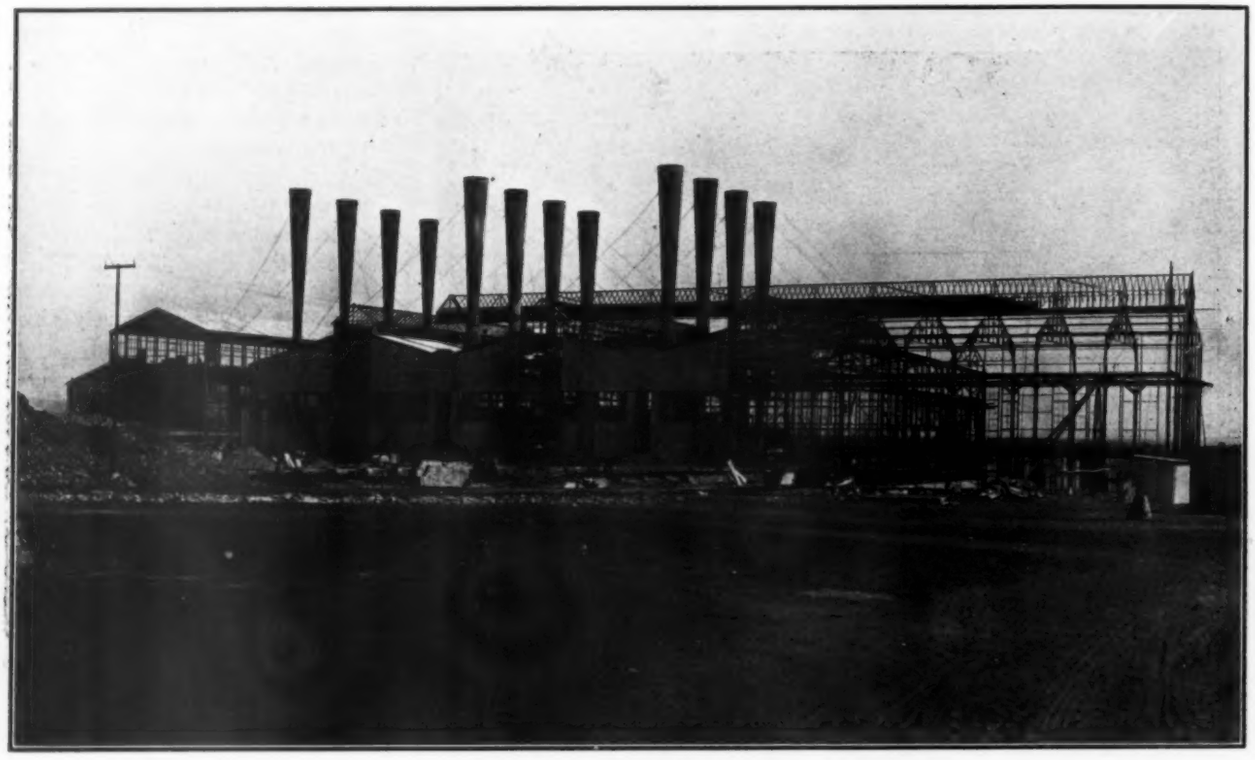
The name of the Victoria Falls is now associated with the Victoria Falls & Transvaal Power Company, formed to distribute power on the Witwatersrand, and, in conjunction with the Rand Mines Power Supply Company, forming a very powerful corporation for the sale of power. These companies have at present three generating stations—at Brakpan, Simmer Pan and Rosherville—all fitted with the most modern steam generating apparatus, and, to complete the trend of engineering from the historical point of view one may mention that the boilers have an evaporating capacity of 20,000 and 30,000 pounds of water per hour. The generation is three-phase, fifty cycles at 2,240 and 5,000 volts, transformed up to 10,000, 20,000 and 40,000 volts, as required. The alternators are driven by steam turbines of the impulse type, and there are two of 4,500 horsepower each at Brakpan, six of 4,500 horsepower each at Simmer Pan, and on completion at Rosherville there will be five of 18,000 horsepower each, driving alternators each of 12,500 kilowatts capacity.

Another special feature of this large power undertaking, from the engineering point of view, is the question of the transmission of compressed air. At Rosherville generating station there will be four steam turbo-driven compressors, each 4,000-horsepower, rotary type, and at the Robinson Deep central compressor station there will be six 4,000-horsepower compressors, air being raised in pressure to 128 pounds per square inch. The present practice of rock-drilling with compressed air necessitates a large supply of compressed air, and within a limited area individual mines will thus be able to purchase compressed air direct at a pressure of 100 pounds per square inch.

A commencement of operations is now being made to install generating plant at Vereeniging under the ideal conditions of having coal mines and water on the spot, and it is expected that 20,000 kilowatts of plant will be erected and running in a comparatively short time. In addition to the above schemes, there is a proposition being put forward to erect a large station at Tweefontein Collieries, and in a draft license, dated June 11, 1910, it is set forth by the applicant that the machinery for generating electric power shall not exceed 100,000 kilowatts.

Thus within a brief period of five years the Rand has shown its progressiveness which the economics of gold mining necessitates, by the exceedingly rapid development of one of the largest power undertakings in the world supplying power, and within a few years most of the mines on the Rand will be run entirely electrically.

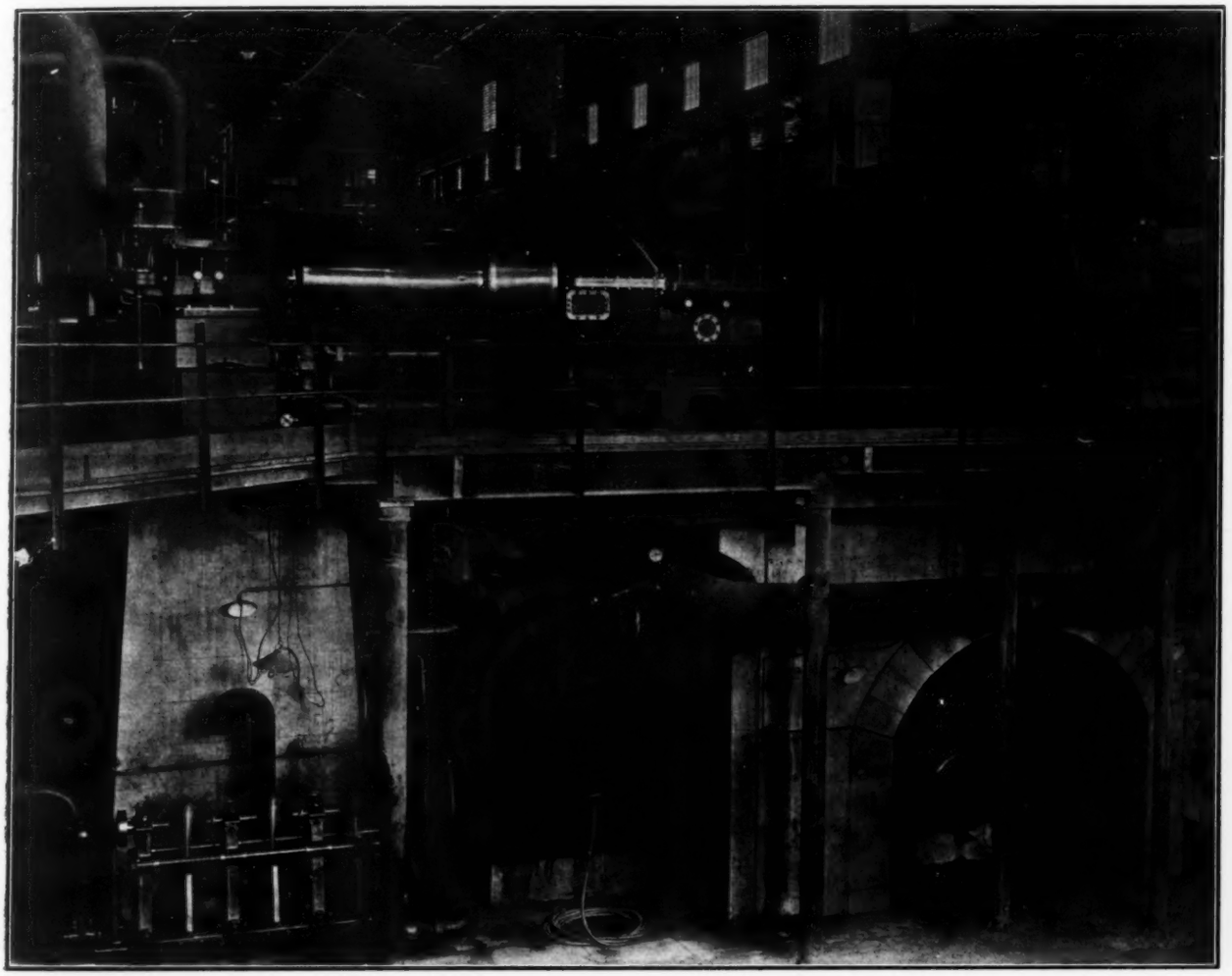
The community will benefit industrially from its various sources of power supplies in that the dawn of the electric era on the Rand will be followed closely by the birth of chemical and metallurgical processes, the mining of base metals, electrification of suburban railways, and an important influence on agriculture, not only from electromechanical operations and in the manufacture of fertilizers, but possibly in directly aid-



ROSHERVILLE POWER STATION.

ing vegetable growth as illustrated by recent work in this direction, whilst socially it may entirely eradicate the domestic sore and free the native from the household.

The geologist, physicist, the chemist and the metallurgist, by their discoveries and devotion to their respective pursuits, have considerably broadened the scope of the various branches of engineering, such as mining, mechanical, civil, and electrical, and the extension of knowledge has become so great that specialization on numerous sub-sections of the individual branches of engineering has become essential, for it is impossible for anyone to keep pace with the march of technical progress in every branch. The wonderful transformation witnessed in the nineteenth century has been accomplished within a period whose duration from the historical point of view is almost negligible, and the conditions of life a century ago appear to us to be well nigh impossible. The production of electric power has played one of the most important parts in adapting scientific knowledge to the benefits of mankind, and whilst much remains for the engineer to accomplish in this direction, the limits of the transformation of heat energy to electric energy and its distribution will probably soon be reached, and, apart from the magnitude of future operations, nothing short of other epoch-making discoveries will materially alter our present methods.



INTERIOR OF EAST RAND POWER STATION.

Effect of Air on Stored Coal.

Experiments on the preservation of Westphalian coal under exclusion of air have been carried out in Germany. The coal consisted of lumps about three-fourth inch in size, and vessels of about one-half gallon capacity were filled with this coal and provided with air-tight covers. The vessels were further filled, either with water, carbon dioxide, flue gases, or sulphurous-acid vapors. Samples were taken and analyzed after two weeks, three weeks, and six months; at the end of this period no further weathering seemed to occur. Parellel tests were made with coal exposed to the air. The different sorts of coal did not all behave equally, but on the whole it would appear that little is gained by keeping the coal under water or in special atmospheres. The loss of gas was little affected by the treatment, and the difference observed might have been less noticeable if the coal had been taken as soon as mined, and not after intervals of from five to eight days; the weathering is most marked in the first days. If anything special is to be done for the storage of coal, roofs should be provided for the coal piles, and thermometers be inserted so as to obtain warning of any tendency to spontaneous combustion.

National District Heating Association.

Third Annual Convention at Pittsburg, June 6-8.

The third annual convention of the National District Heating Association was held in Pittsburg, Pa., June 6, 7 and 8, 1911. Headquarters were established in the Fort Pitt Hotel, the meetings being held in the banquet hall. Tuesday morning was devoted to committee meetings, the first regular session being called to order by Pres. George W. Wright at 2 p. m.

In his presidential address, which immediately followed the opening, Mr. Wright reviewed the work that has been accomplished by the Executive Committee and officers of the Association during the past year. He spoke of the campaign carried on for new members and of the encouraging results shown, also of the work done by the various committee chairmen and members in preparing reports, papers, etc.

President Wright then introduced H. M. Irons, assistant city solicitor of Pittsburg, who, on behalf of Mayor Magee, cordially welcomed the delegates to the city. He called particular attention to the industrial attractions of the city. Robert Garland, vice-president of the Chamber of Commerce, also welcomed the delegates to Pittsburg, on behalf of the business interests.

The report of the secretary-treasurer was then presented by D. L. Gaskill. This report showed the association to be in a sound financial condition. During the year sixty-one new members were obtained.

Following this the report of the Committee on Data was presented by E. J. Keifer, of Easton, Pa., chairman. Upon the suggestion of Secretary Gaskill it was decided to withhold this report for publication in the proceedings until next year. A motion was carried instructing the Committee to continue its work.

The paper entitled "Heating and Ventilating Equipment of the City Investing Building, New York City," by J. B. Holbrook, was then read by Mr. Gaskill.

EQUIPMENT OF A LARGE OFFICE BUILDING.

This paper describes in detail the heating and ventilating equipment of the City Investing Building, New York City. Brief mention is also made of the electrical and mechanical installation, the building being provided with an isolated power plant. The building is heated on the two-pipe up-feed vacuum return system, has complete mechanical-exhaust ventilation, an electric vacuum-cleaner plant, motor-generator service for office annunciators, etc., and contains generally all up-to-date devices which go to make up the ideal office-building equipment. There are also twenty-one elevators. The power plant is located in the sub-basement and contains 1,950 horsepower in boilers and 1,050 kilowatts in generating equipment with the usual auxiliary apparatus, pumps, heaters, etc. The building proper is twenty-six stories high with a tower thirty-three stories, a total height from the sidewalk of 470 feet.

There being no discussion, the paper entitled "Handling Customers," by George W. Wright, was presented by the author.

HANDLING CUSTOMERS.

This paper covers very fully the policies that should be adopted by a central-station heating company towards its customers. Advice to customers is the first phase of the question discussed. It is advisable to give each a pamphlet explanatory of central-station heating, how the heat is generated and distributed, how condensation in the main is taken care of, the use of the heat recorded and a full description of the meter and instructions for reading same. Regarding new customers the paper emphasizes the importance of advising a customer of any changes in his heating system that are necessary before connection is made to the central-station system. In making estimates of the cost of a service for a new customer the utmost care should be exercised and consideration given to the personal element. The matter of complaints, meter reading and temperature records should also be given prompt attention. Under the heading "Loss of Revenue" the paper points out how revenues are ofttimes decreased through some minor trouble in the system. To remedy this condition the author recommends that complete data be filed on each building heated so that if any marked changes are noticed in the steam used an inspection to determine the cause can at once be made. These records are also of value in advising new tenants of a building what the heating service will cost.

In reply to a question by C. Evans as to what provision is made in the contract which will cover the estimate if the meter should fail to register, Mr. Wright said that the returns would be estimated on the basis of the consumption during the balance of the month as provided. No trouble is encountered in having such contract signed.

Mr. Donnelly said that he has found that a recording thermometer is a very good substitute for a condensation meter as a temporary expedient. If the inside temperature is plotted as a diagram with the outside temperature shown below, the difference between the two lines represents the heat which has been added to the building and indicates the work done by the heating apparatus. Mr. DeWolf also spoke in favor of the recording thermometer and cited instances where it was instrumental in satisfying dissatisfied customers. Mr. DeWolf added that the heating company pays for the thermometer.

Messrs. Schott and Spencer spoke of the efforts to satisfy the customers of their respective companies. Mr. Spencer said twenty-four-hour patrol service is maintained to answer any trouble calls and complaints. He also spoke of theft of steam and said that several thousand dollars have been collected in one season through a private detective department maintained by the company.

Mr. Rogers said that it is a good practice to inspect a customer's installation about once a month.

President Wright mentioned two instances where steam was used excessively on account of ignorance on the part of the customer.

Mr. Garner spoke of the difficulty of holding customers, who had enlarged their property, when billed at a higher rate in accordance with the increased area of the premises.

WEDNESDAY MORNING SESSION.

The Wednesday morning session was called to order by President Wright at 9 a. m. and the paper by A. C. Gillham, of Chicago, entitled "Heating Franchises" was presented. Owing to the absence of the author, Mr. Schott read the paper.

HEATING FRANCHISES.

This paper outlines some of the salient features which should be carefully safeguarded in the preparation of a heating franchise. The ideal franchise is one distinguished for brevity in granting the necessary permission and authority for the use of the streets, alleys, avenues, etc., in the construction, maintenance and operation of a heating plant, for the longest term of years permissible under the laws and without the usual restrictions pertaining to rates, franchise taxes, etc. However, the author states that it has become practically impossible to secure a heating franchise without being compelled to deal more or less with a part or all of the following subjects: Legality and preparation; use of streets, alleys, avenues, etc.; extensions to mains and service lines; rates to be charged consumers; rules for estimating radiation; guarantee of service; franchise term of years; protection to city; franchise tax, and forfeiture of franchise. Discussing these topics in the order in which they appear, Mr. Gillham recommends that a competent

attorney should prepare the franchise, covering the legal phases in as brief a form as possible, carefully observing all state and municipal laws affecting the grant. If full and unlimited permission and authority for the use of streets and alleys cannot be secured without showing the exact location of the initial installations, a provisional clause should be added making it compulsory on the part of the city to grant additional permission to make necessary changes in the plans if in the prosecution of the work it is found impractical to install the system in accordance with the original plans. Regarding extensions, the author recommends a clause making it optional with the operating company, in the matter of making the extensions. In considering rates to be charged, it is recommended that only maximum meter and flat rates should be named in the franchise and these should be governed by the price of fuel and other operating expenses, etc. The rate clause should also be based upon the rules for estimating radiation. No reference should be made in the franchise to guarantee of service. If a franchise tax is imposed it should be rated that the city may only receive its remuneration from the surplus earnings.

W. Partridge opened the discussion, emphasizing the point that no detailed system of rates should be specified in a franchise. Only the maximum or base rate should be given.

W. Schott called attention to the franchise held by the Indianapolis company.

Mr. Mueller, speaking of franchise taxes, said that the company he represents has to pay $30 per mile of main in addition to two per cent of the gross receipts. He asked for the experiences of other companies in this matter.

Mr. Schott said that only two heating companies in Indiana were paying a franchise tax. These were in Indianapolis and Terre Haute. The tax was five per cent and two per cent of the gross receipts respectively.

W. Partridge said that Mr. Mueller's case brings up another matter that should be included in a franchise—namely—if it becomes necessary to include a gross-earnings clause, that clause should specify that it is in lieu of all other special taxes.

J. L. Hecht said a franchise should cover the expense involved in connection with moving mains due to changes in street level, or track elevation or any work beyond the control of the heating company.

The next paper, entitled "Coefficients of Heat Transmission," was presented by Prof. J. R. Allen, of the University of Michigan, the author.

COEFFICIENTS OF HEAT TRANSMISSION.

Heat is lost and conducted from a body in three ways, by radiation, conduction and convection. In heating work it is very important to know the heat loss through various forms of heating surfaces. Surfaces are of two classes, those losing heat by the natural circulation of air produced by the heated surface itself and those in which there is forced circulation. In the first class the loss is largely by radiation, in the second largely by convection. The transmission of heat depends upon the difference in temperature between the air and the radiator multiplied by a constant depending upon the form and condition of the surface. Experiments have been conducted at the University of Michigan for twenty years to determine the coefficients of transmission under different circumstances. This coefficient is the amount of heat lost per square foot of surface divided by the difference in temperature between the radiator and the air, and has values varying from 1.27 to 3.27. It is lower for bare cast iron than bare wrought iron, and is lower for vertical than horizontal coils. It increases somewhat as the difference in temperature increases. It is larger in rooms with a large window surface such as green houses. It decreases somewhat as the humidity of the air increases. The painting of radiators greatly affects transmission of heat. Metal pigments, such as aluminum, copper and bronze reduce the transmissoin. Enamel, lead and zinc paints show almost no loss. A terra-cotta enamel produced a slight increase in transmission over the original surface. The loss of heat depends largely upon the surface conditions and very slightly upon the conduction of heat through the metal; consequently the thickness of metal has very little effect. In indirect radiators where the air passes over the surface at a high velocity the coefficient is taken as the quotient of the previous value divided by the cubic feet of air passing per hour per square foot of surface. With indirect pin radiation the coefficient was found to vary between 1.2 and 2.0, the lower values applying to the higher velocities of air. The coefficient of transmission for fan coil radiation was also determined and it is expressed in this case in terms of the linear velocity of the air. Knowledge of these coefficients will enable the engineer to determine the heat losses even when the conditions of operation are exceptional. Much experimental work yet remains to be done as the laws governing heat transmission through surfaces is not well determined. An elaborate series of experiments with fan heaters is now being carried on at the University with the hope that more definite information may be obtained as to the effect of velocity.

A. C. Rogers opened the discussion, speaking of the educational work that was necessary to convince consumers that bronze covering affects heat radiation.

Mr. Donnelly spoke of the value of a practical test on radiators. He said that the coefficient of heat transmission could be obtained from meter readings in a much more practical manner than by laboratory tests.

R. D. DeWolf asked if black paint had been included in the tests. Professor Allen said that the nearest to black was a luster green enamel. Four per cent less radiation than with an unpainted radiator was obtained.

The paper on "Results of Measuring Station Load by Venturi and General Electric Meters" was then presented by F. C. Chambers.

MEASURING STATION LOAD.

Mr. Chambers opens his paper by a description of the plant of the Springfield (Ill.) Light, Heat & Power Company, which in addition to its commercial lighting business supplies current for power and street-railway purposes, and both steam and hot water for heating purposes. The plant has ten boilers, and four engines. There are three condensers, two of which are used exclusively for heating the circulating water for the hot-water system. The operation of the plant is described in detail. Great flexibility is provided for so that the plant may be run condensing, non-condensing or partly one way and partly the other. During the coldest of the heating season there is not sufficient exhaust steam for the steam-heating system; therefore, considerable live steam is also supplied to it. The flexibility that is attained is of peculiar benefit in enabling the plant to be run under the most economic of the greatly varying conditions. The steam-heating system is principally in the business district and has connected to it about 220,000 square feet of radiation. The hot-water system is chiefly in the residence district and provides a connected total radiation of about 320,000 square feet. The method of operation of both these heating systems is given in considerable detail. An ingenious way was found to regulate the flow of water in the hot-water heated houses, these being controlled by thermostats. The paper concludes with a large number of tables and curves giving the results of tests with the two types of meters that form the subject of the paper.

Mr. Schott asked Mr. Chambers regarding the accuracy of the flow meters. Mr. Chambers said that he had no direct means of checking them but that the quantity of steam measured by them checks with the amounts of water evaporated as measured by the Venturi meter on the boiler-feed line.

C. Evans asked if there is any pulsation in the lines on which the flow meters are installed. Mr. Chambers said there is very little.

Mr. Richardson asked as to the accuracy of the results in table No. 5. Mr. Chambers said that these results were obtained by placing a union in the center of a piece of pipe approximately two feet long and inserting a disk in this union. Then a constant differential pressure was maintained on this disk and the quantity of water which passed through the disk in a given length of time was discharged into a tank on a pair of platform scales and the quantity carefully weighed.

THURSDAY MORNING SESSION.

The meeting on Thursday morning was called to order at 9:30 a. m. The election of officers was the first business taken up. The following nominees were declared elected: President A. D. Spencer of Detroit; first vice-president, Warren Partridge, Springfield, Ill.; second vice-president, R. D. DeWolf, of Rochester, N. Y.; third vice-president, Cadwalder Evans, Jr., of Pittsburg, Pa.; secretary-treasurer, D. L. Gaskill, Greenville, Ohio. The

new executive committee members are A. C. Rogers and E. J. Keifer.

The paper by R. D. DeWolf, on "The Preparation of a Rational Rate System" was then presented

RATIONAL RATE SYSTEM.

This paper is a discussion of the application of the three-charge rate system to steam heating. After pointing out that a flat-rate system is inherently wrong, since it discourages economy by the consumer, reasons are given for favoring the three-charge system. The first element of charge is a fixed quantity per consumer and depends upon the cost of watering, billing, collecting, a portion of the overhead expenses, and fixed charges on so much of the capital as would be required for a minimum plant and distribution system. The second element of charge depends upon the maximum demand of the consumer and is made up of fixed charges on so much of the capital as is necessary to provide a plant capable of delivering the maximum demand and stand-by expense for readiness to serve. The third element of charge depends upon the consumption of the customer as shown by a meter. Reference is made to the large amount of work which has been done in developing such a system of rates for electricity. A system for live steam can evidently be worked out along the same lines. With combined service some interesting problems are involved and the numerical relations are worked out in an appendix.

There is an undoubted field for the isolated plant at present in which the central stations find it difficult to compete because they are not prepared to furnish the same service. In order to do this they must supply both power and heat. In operating his own plant the consumer of this class operates under good conditions when the exhaust steam from his power plant is just sufficient to meet his heating demand. When the power demand exceeds the heating demand exhaust steam is wasted. When the heating demand exceeds the power demand, live steam must be used to make up the deficiency of exhaust steam. Under either of these conditions the operating cost is higher. The rate system must consider the ratio between the power demand and the heating demand and must be so planned that the consumer with the advantageous ratio will receive a better rate than one whose ratio is uneconomical. Charges for live steam or for exhaust steam alone can be worked out on the same basis as power rates. When both power and exhaust steam are furnished a combined expression must be derived. The simplest method consists in metering the current and the condensed steam. The current can be charged for as under the power rate system. The charge for the exhaust steam will then be the charge which would be rendered under the system worked out for a non-condensing generating station for both power and heat, crediting to this the rates charged for the power for such portion of the steam required for heating as would be furnished by a non-condensing station, plus a charge based on the live-steam rate for any additional steam. The maximum demand charge should vary at different seasons of the year. The consumer whose demand comes during an idle period of the year should receive a lower rate than the consumer whose demand comes during the peak period. On account of this diversity-factor in power and heating load and the ratio of power to heating load, a central station is able to combine the heating demand and power demand more effectively than the isolated plant. This is partly offset by the transmission losses.

Warren Partridge opened the discussion. He said that in making rates there are three fundamental points—that the gross income of the company must allow for all of the operating expenses and leave a reasonable return on the investment. The second point is that the rate must be capable of getting all of the business, which means that in some cases you must make a larger profit than in other cases on account of the competition. The third point is that you must not discriminate; that is, between consumers having identical conditions. In such cases you must give the same rate and there must also be a relation between rates charged to consumers having different conditions.

A. D. Spencer thought that a flat rate is the best form of rate.

A paper by W. E. Dowd, Jr., of Philadelphia, entitled "Superheated Steam" was then presented by the author.

SUPERHEATED STEAM.

Mr. Dowd's paper deals with the methods of superheating steam and the advantages obtained by using such steam. Most commonly the superheating tubes are installed inside the boiler setting; this is the attached type. In the separately-fired type an independent furnace is used. The former type is used where only moderate superheat is required and the duty is comparatively constant; it is practically automatic in operation and requires no extra floor space. The second type is used where high degree of superheat is needed or where only part of the steam is to be superheated or only during part of the time; while it requires separate attention, floor space and fuel, its capacity is very elastic. The value of superheated steam in an engine, turbine or pump is that it prevents condensation, the steam economy resulting from its use varying from one to three per cent for each ten degrees of superheat. In a simple, direct-acting pump 150 degrees of superheat reduce the steam consumption by fifty per cent. Practice now favors a total temperature of 500 degrees Fahrenheit at the engine-room throttles. In process or heating service superheated steam is of value because of its increased calorific value. Thus it promotes up to twenty-five per cent increase in capacity or to five per cent decrease in steam consumption. For heating service temperatures as high as 1,000 degrees Fahrenheit have been successfully used, but this should not be exceeded. A combination of both types of superheaters may frequently be used to advantage where exhaust steam has to be supplied to a great distance; in such case the separately fired superheater should be placed close to the engine exhaust and should add one degree of superheat for each ten feet of transmission pipe. Superheaters should be favorably considered if their use would effect a net interest on investment of ten per cent above depreciation and maintenance charges.

Mr. Morrissey opened the discussion citing his experiences with superheaters. The temperature gets as high as 725 degrees (Fahrenheit) necessitating the removal of all cast-iron piping. Mr. Dowd said that all good superheaters are guaranteed not to fluctuate over fifteen degrees when the boilers are operating from ninety per cent of their load to their maximum overload capacity.

Mr. Bishop asked if the steam temperature could be raised so as to make it effective for cooking in hotels. Mr. Dowd said that it depended on the temperature desired in the ovens—if high the process is not economical.

R. D. DeWolf said that in plant operation he frequently finds that boilers will vary from 50 to 100 per cent. He asked what the variation in superheated steam is under those conditions.

C. Evans asked if a separately fired superheater has been applied to lines for residence and store heating and whether it would be practical. Mr. Dowd said it would if the load was constant on the engine.

Mr. DeWolf said that one point to be considered in using superheated steam is that the customer will get more heat without extra cost—if the heat is metered.

After an extended discussion on minor points brought out in the paper the meeting adjourned until the afternoon.

AFTERNOON SESSION.

The first paper presented at the afternoon session on Thursday was by W. J. Kline, of Lockport, N. Y., entitled "Best System of Radiation for Economy and Steam Consumption When Fed From a District-Heating Station."

BEST SYSTEM OF RADIATION.

This is a debatable question, since there are many systems from which to choose, each possessing some merit. The author presented a few fundamental principles in the piping of buildings which result in the highest operating efficiency. Artificial heating may be classified as direct or indirect, the piping arrangements being divided into two general divisions, known as the "one-pipe" and the "two-pipe" systems. Both are variously modified and known by various names, especially the latter. In the operation of a central-station heating system, it is of great importance that all buildings which are connected to the underground system should have properly designed piping, no matter what system is employed; and further, the installation should be so designed that a pressure of one pound above atmosphere at the point of entrance of the service main to the building will be sufficient to circulate steam throughout the system in maximum conditions of demand and produce the desired result; and to operate under low pressure, as the exterior, or street system, may then be operated at its lowest average pressure. This results in the highest degree of operating economy, by reason of being able to supply a maximum amount of radiation through the existing mains, reducing transmission losses as well as reducing the back-pressure in case of combination plants. It is true there is an economical limit in pipe sizes beyond which it is not advisable to go to secure low operat-

ing pressure on the underground system, but in a large majority of cases five pounds initial pressure should not be exceeded. It may be laid down as a principle that any system of steam piping may be operated by a central-station service, and that better results will be attained than by the operating of individual boiler installations. It does not necessarily follow that the desired low-pressure operation will be possible unless changes in existing piping are made in some instances, but where piping is properly designed in the original installation there will be no question of a satisfactory service being supplied to the customers. Some of the systems of piping buildings possess inherent advantages over others, due to the fulfillment of certain conditions which are necessary for economical operation. The one great essential for economical operation is regulation. This is vital, whether the heat is sold by flat rate or by meter. In the one case the company is the principal gainer, and in the other the consumer. Many schemes have been devised for the automatic regulation of the temperature. The devices have taken the form of thermostatic control, which is a primary element, with vacuum pumps, drip seals, regulating valves of various kinds, etc. The ultimate success of these devices, and of many systems of piping for that matter, depends largely on the personal equation, and in addition are subject more or less to mechanical failure. In all interior systems the minimum of waste occurs with the lowest operating pressure. Therefore, the best system is one which will operate satisfactorily on ounces of pressure instead of pounds.

The system which the author described operates on a normal pressure of five ounces and a maximum of eight. In order to accomplish the best result, it is necessary at certain times to utilize only a small percentage of the radiating surface. In the ordinary type of steam piping, the admission of steam to the radiator is at the bottom. This method of supplying steam results in heating the entire surface of the radiator, thus allowing the radiation of a much greater number of heat units than necessary. Due to inconvenience of adjusting valves on radiators of this type when once turned on, the quick cooling of the room is obtained by opening doors and windows, with attendant waste. It has been found that a very satsifactory regulation and economy can be obtained by using the hot-water type of radiation, which has an open passage across the top as well as the bottom, and making the supply or inlet connection at the top instead of at the bottom of the radiator. Regulating the supply of steam is accomplished by means of a valve placed at the top. With this arrangement a small quantity of steam only may be admitted, and consequently only that portion of the radiating surface necessary for comfort is heated, the remaining surface of the radiator acting as an economizer in removing the sensible heat remaining in the condensation. The installation becomes essentially a two-pipe system. The air is forced out at the bottom through the return piping, which necessitates bringing all of the return pipes to a common point, and then venting. For convenience in the circulation and control of the amount of steam required, a graduated valve has been devised. These valves are calibrated for the amount of heating surface to be supplied under a maximum pressure of eight ounces. The opening provided in the valve is so proportioned that only eighty-five per cent of the surface of the radiator will be heated when the valve is fully opened at times of maximum demand. The remaining portion of the radiator cools the condensation as it trickles down the interior walls, and thus the sensible heat in the condensation is reclaimed. Heating systems of this kind properly designed and installed may be operated so that the temperature of the condensation in the returns is only slightly above the temperature of the room, thereby making it unnecessary to cover the returns. A system of this type may be operated with from 20 to 35 per cent better economy than it is possible to obtain by any other system under parallel conditions. This is known as the atmospheric system and its essential features are: (1) External low pressure of operation without resorting to mechanical means to produce circulation. (2) Ease of regulation by an accessible graduated or fractional valve, designed for the particular radiator on which it is installed. (3) The absolute elimination of noise by bringing the steam into the top of the radiator, allowing the condensation to flow by gravity from the bottom of the radiator, thus eliminating opposing currents of steam and water. (4) The absolute distribution and control of the heat when and where required by the operator. (5) The elimination of air vents and possible odors.

The first cost is no greater than the ordinary type of installation, and much less than some of the patented systems. Simplicity of regulation is attained and the consumer receives the greatest amount of benefit from the heat for which he is to pay. While flat rates are never at any time considered advisable, companies operating by this method of charging will find this system of advantage, as the method of distributing the steam reduces the possibility of waste. It will always be found, however, that the amount of steam consumed by a flat-rate customer will be much greater than where meters are in use, no matter what method of piping is employed.

R. D. De Wolf asked if the atmospheric system has been installed on mains of either the single or two-pipe system and what effect the variation in pressure in those mains has upon the amount of steam furnished to the radiator. Mr. Kline said that a reducing valve is placed where each service enters the building.

Messrs. Payne, Dunlap, Bishop and Higgins also asked questions pertaining particularly to details of installation as brought out in the paper.

This discussion was followed with the paper by A. C. Rogers, of Toledo, Ohio, entitled, "Different Hot-Water Heating Systems and Methods of Connecting Them to a District-Heating System."

HOT-WATER HEATING SYSTEMS.

This paper contains diagrams of eleven different systems of hot-water heating, with explanations of how each one should be modified when connections are made to a district heating system. District hot-water heating is a forced feed and the best results and economy come from maintaining a gravity flow and outflow to all radiators. Supervision of house installations when connected to district heating is necessary. With new work this is easily accomplished, but with old systems difficulties may be expected. An owner may be indifferent to results and economy when running his own plant, but very exacting when getting service from a central station.

Mr. Spiehler asked if Mr. Rogers has had any trouble with lime in his system. Mr. Rogers said that they now have practically no trouble, owing to their method of operation.

Mr. Payne asked whether in hot-water piping the principles of the atmospheric system had ever been applied. Mr. Rogers said that his company has not had much success by connecting hot-water radiation at the top because it works against gravity action. On the two-pipe system the only advantage of connecting to the top is the self-venting action.

The discussion was closed by Mr. Hect, who said that in several cases the heating boilers in a property connected to the lines of the heating company were cut off, as recommended in the paper, but caused dissatisfaction on the part of the customer.

The report of the Committee on Radiation, of which W. K. Martin was chairman, was then read by R. D. De Wolf. This report presents a few formulas used by different heating companies in arriving at the necessary amount of radiation required to heat a building. The Committee regretted that more replies had not been received to its requests for data and asked to be continued.

Under the head of unfinished business the matter of a question box for the Association was taken up. Also, a brief discussion was held on the advisability of the Association having an emblem. Both suggestions were adopted.

A vote of thanks was then extended to the various speakers and hosts during the convention.

The entertainment features were most enjoyable. On Tuesday evening the delegates visited some of the steel mills in the vicinity and later attended a theater. Wednesday afternoon was devoted to an inspection tour of the works of the Westinghouse Electric & Manufacturing Company and on Wednesday evening the delegates were the guests of the manufacturers at a smoker in the Fort Pitt Hotel.

Semi-Automatic Telephones.

In Amsterdam, Holland, a telephone system which is semi-automatic is being tried. An operator receives the call in the manner common to manual systems, but instead of making the connection by means of plug and jack, she simply presses a series of buttons which actuate the automatic apparatus for making the connection to the line which has been called for.

Hoosac Tunnel Electrification.

The electrification of the Hoosac Tunnel, the longest tunnel in the United States, has been completed and electrically operated trains will be passing through in a short time.

The close is thus announced of one of the most interesting pieces of railway electrification that has been carried out in recent years.

Work on the installation of electrical apparatus commenced last autumn, when, owing to the success met with in the electrification of the New York, New Haven & Hartford lines near New York it was decided to follow their practice in the use of an 11,000-volt, twenty-five-cycle, single-phase system.

Everything has been done in record time since the actual start of the work on October 3, 1910, and the electrical equipment was placed in commercial operation on May 27. The powerhouse itself was built complete in less than sixty days. Steam was raised in the boilers in three and one-half months from the time of breaking ground, and the turbines were run in practically four months from the time of starting work. In accomplishing this electrification it was necessary to build a powerhouse with an ultimate capacity of 12,000 kilowatts, a transmission line 2.42 miles in length, and to electrify 21.29 miles of track, including 9.49 miles of track inside the Hoosac tunnel. Legislative powers have been obtained for the Berkshire Railway Company to supply power when necessary.

The electrified zone extends from a point west of the station at North Adams to a point east of Hoosac Tunnel station on the eastern side of the Hoosac Mountains, a total distance of 7.91 miles, of which 2.09 miles constitutes the western approach to the tunnel on the North Adams side, 4.75 miles in the Hoosac tunnel and 1.07 miles in the eastern approach. The tunnel has two tracks and the approaches three tracks for traffic, and in addition the yards were electrified on both approaches. The total track electrified is as follows:

West approaches, 41,245 feet; Hoosac Tunnel, 50,101 feet; east approaches, 21,051 feet. Total, 112,397 feet, or 21.29 miles.

The most serious problem in connection with the electrification was the work to be performed inside the tunnel itself. To do this work the engineers designed two platform construction trains for the use of of the contractor, each approximately 500 feet long, and equipped with electric lights and compressed-air system for the use of rock drills throughout. A machinery car equipped with an air compressor and electric light generator was placed next to the locomotive. The locomotives used oil for fuel.

Serious difficulty was caused by the passing of the regular trains, so that altogether the work trains in the tunnel were able to put in effective work for less than fifty per cent of the time they were in commission.

The electrification has been carried out under the general direction of E. H. McHenry, vice-president, and of W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, consulting engineers being L. B. Stillwell and H. S. Putnam.

Large Virginia Hydroelectric Plant.

The Appalachian Power Company, of Bluefield, W. Va., has recently been taken over by H. M. Byllesby & Company, Chicago, Ill., and work has already been started on extensive improvements. It is also proposed to construct a large hydroelectric plant on the New River, in Virginia, where 90,000 horsepower will ultimately be developed.

The Appalachian Power Company already serves the towns of Bluefield, Pulaski and several surrounding towns, and with the increased power which will be available upon the completion of the hydroelectric plant, power will be supplied to the mines and other industries in the vicinity.

Veile, Blackwell & Buck, of New York, N. Y., are the engineers.

A Bavarian Hydroelectric Development.

A power station is in course of erection on the Isar River, in Bavaria, partly for supplying power to the State Railroads, now being electrified. The head is about 600 feet and the available supply 5,500 gallons per second. Pelton wheels are to be used on horizontal shafts. The yearly output has been estimated at 120,000,000 kilowatt-hours.

Central Electric Railway Association.

The June meeting of the Central Electric Railway Association will be held at St. Joseph, Mich., June 22. The headquarters of the association for the meeting will be at the Edgewater Club.

SOME POINTS INVOLVING MECHANISM AND ADVANTAGES OF VACUUM STEAM HEATING.[1]

BY J. W. HOOK.

The application of the vacuum principle to steam heating practice is gaining rapidly in popularity. Hardly a large building is being erected nowadays that does not contain, when completed, a vacuum system of steam heating, oftentimes combined with automatic temperature control in each room, and a complete tempered air blast system of ventilation. These features which a few years ago might have been called luxuries have developed to such an extent that now they are almost considered necessities. In some states laws have been enacted which regulate to a considerable extent the kind of heating and ventilating apparatus that must be installed.

The vacuum principle of steam heating means the removing of obstacles in front of the steam during its circulation throughout the radiation in a building rather than energizing it at the boiler so that it will overcome these obstacles and push them ahead of itself and out of the system.

The great obstacle in steam-heating work is air. The very first thing to be done in starting up a heating system is to get rid of the air. Once the air is removed the operating of the plant is simplified. After that the water of condensation as formed is practically all that has to be contended with.

The vacuum principle simplifies the process of getting rid of the water of condensation as it accrues and the air that is always present in the radiation when the system is first started up and that accrues in radiators which are partially or entirely shut off. In the positive elimination of water of condensation and air from the pipes and radiators provision is made against noise in the system and a way is opened for steam to reach and fill every part of the radiator. Since the efficiency of a radiator is dependent upon the amount of steam it can condense under certain weather conditions, the importance of getting rid of the water of condensation and air is apparent.

But primary to the necessity for efficiency comes the importance of reducing the energy required behind the steam to push it through the system.

1 From *The Iowa Engineer.*

This is especially true in cases where exhaust steam is used for heating purposes. Exhaust steam ordinarily is supplied by steam engines, which are operated upon the differential in pressure between the steam entering the cylinder and that at which it is exhausted. If the engine must force the steam through the piping and into the radiation it is apparent that back pressure would be exerted against the engine piston tending to reduce the power of the engine and making it uneconomical.

Essentially speaking, vacuum systems of heating are two-pipe systems. By "two-pipe" is meant one supply pipe installed to supply steam to the radiators and one return pipe connected to each radiator through a small steam trap to carry the water of condensation and air out. The mission of the steam trap is to prevent steam from wasting out of the radiators and at the same time to allow for the free passage of water and air. There are one-pipe vacuum systems in which air valves are located on radiators to allow for the discharge of air from within, but to close against the entrance of air to the radiator from the outside. Again there are vacuum systems with two pipes, one a supply pipe and the other a return pipe for carrying the air only out of the radiation. The former has its objections in the air valves on radiators, while the latter is a hard system to regulate, it being necessary to either entirely open or close the inlet valve to the supply pipe, which plays the dual part of supplying the radiator with steam and also carrying back the water of condensation.

The two-pipe system in which the return pipe carries away both the water of condensation and air has its advantages in case of regulation, and smallness of pipe sizes. The vacuum is produced by means of a vacuum pump (usually located in the boiler room) connected to the ends of the return lines. This pump draws all water of condensation and air out of the radiators and discharges into a vented receiver from which the air escapes and the water is pumped back into the boiler.

In exhaust-steam heating the steam before being delivered to the heating mains is passed through an oil separator which removes the oil and other foreign matter so completely as to make it possible to return the condensed steam to the boiler.

The most important feature in any two-pipe vacuum steam-heating system is the radiator trap placed between each radiator or heating unit and the return pipe. This trap is really the distinguishing feature of a two-pipe vacuum heating system, for from it comes the name of the particular kind of system installed.

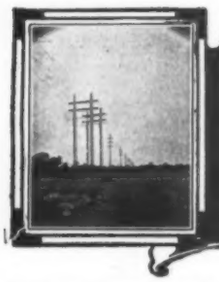
The function of the radiator trap is to automatically allow for the free passage of all water of condensation and air out of the radiation and to close the instant steam begins to pass through the trap. By keeping the steam out of the return line it is possible to produce and maintain a high vacuum in it or in other words a high differential of pressure immediately between each radiator and the return line. When water of condensation and air reaches the trap it opens and the suction in the return line quickly draws the water and air out. Steam immediately rushes in to fill the space previously occupied by the water and air and the trap closes. Since both water of condensation and air are heavier than steam, and since the radiator trap is located upon the lowest point of the radiator, it is apparent that any or either, on accruing, will settle about the trap. With the radiator completely drained of all water and air the supply of steam to the radiator can be regulated to meet weather conditions, without creating annoying noises in the radiator.

The operation of the radiator trap demands, of course, a certain motive force operating in one direction for water and air and in exactly the opposite direction for steam. This motive force is procured differently in different traps, and in classification we may say that the methods of producing it are two in number, first, the flotation method and second, the thermostatic method.

The flotation method utilizes a metal float suspended loosely in a chamber of the trap, which rises and falls according to the accumulation of water in the chamber containing it. When water surrounds the float, it rises, at the same time opening an orifice which leads to the return line and through which the water passes. Steam following does not surround the float until the water in removed and the trap closed, and hence is retained in the radiator. There are two objections to the float method. First, any provision made in the trap to allow for the discharge of air from the radiator will also allow of waste of steam, and second, to procure enough motive force to make for positive and noiseless operation requires too large a trap, one that is unsightly and not desirable for some classes of heating service.

The thermostatic principle, while comparatively old, has only been commercialized in the past few years. A radiator trap operating under this principle uses for its motive force the power contained in heat itself, depending for its operation upon the fact that steam in a radiator is higher in temperature than the water of condensation or air, which collect at the bottom of the radiator. The principle feature of a thermostatic radiator trap is an expanding member (to which a valve is anchored) which shortens and elongates in proportion to the temperature of the medium surrounding it. The latest application of the thermal principle is to a trap whose expanding member is a corrugated hollow receptacle containing a combination of volatile fluids. These fluids vaporize in direct proportion to the temperature of the steam surrounding the disk containing them. Enough vapor is always produced in the disk by the heat of steam surrounding it to form an internal pressure great enough to overcome the pressure produced by the steam at its corresponding temperature. Thus when steam is present the disk expands and seats the valve over the orifice in the trap and the trap is shut off against steam. Subsequent water of condensation and air surrounding the disk at a lower temperature condense enough vapor contained within it to reduce the internal pressure and the pressure on the outside collapses the disk and the trap opens. Since water of condensation and air is always from one-half to two degrees colder than the steam in the radiator, it follows that a trap of the type above described will perform its duty successfully.

The cost of installing vacuum steam is probably a little greater than with single-pipe steam or hot water. There is some compensation, however, in the smaller pipe sizes, and consequent less labor cost where the vacuum system is used. But greater than all this is the comfort and satisfaction to be gained from vacuum steam in its easy regulation, and ease and economy of operation. This is especially apparent in high buildings.



CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

THE DESIGN OF UNDERGROUND TRANSFORMER MANHOLES AND JUNCTION BOXES.

BY FRANCIS H. DAVIES.

The inconveniences attaching to the operation of underground transformer manholes very naturally give rise to preference for an aboveground location in which it is easy to provide greater space and better lighting, and where ventilation and drainage troubles are unknown. Still, occasions frequently arise in an underground system of mains in which manholes of the former class are necessary, and experience has shown that while they may be a continual source of trouble, if improperly designed, it is quite possible to operate such stations in a highly satisfactory manner, even under adverse conditions, provided due care and forethought are brought to bear on their construction.

The first step, namely, the choice of a site, is an important one. Assuming an ordinary city street, it is necessary to take into account the state of the subsoil as regards congestion with sewers, pipes and conduits; interference with traffic both in building the manhole and in operation when it is frequently necessary to leave the manhole open during inspection or other work; the proximity of drains, which, by overflowing in bad weather, may flood the chamber; or the presence of stores where the nature of the trade calls for frequent washing down and consequent flooding of the sidewalk and manhole covers. In addition, the gradient, if any, of the street should be taken into account, as it will be obvious that a manhole located at the bottom of a hill will be more liable to the influx of water than one situated at the top or on the slope. Such points as the above are very apt to escape attention, and they all have a more or less important bearing upon satisfactory results.

The chief enemy of underground construction is water, and second to this in the case of electrical work comes gas, emanating either from street mains or generated by heat from the insulation of cables. The design must, therefore, aim at two ends: first, to keep to a minimum the influx of gas and water, and, secondly, to provide efficient means for ridding the chamber of any small quantities of either which may find their way in. This implies a construction as nearly waterproof and gasproof as possible, fitted with efficient ventilation and draining arrangements.

Of secondary importance to these considerations, although still matters of moment, are questions of convenience in operation, ample space for movement, proper facilities for raising and lowering transformers through the manhole, and arrangements whereby cables, possibly of the heavy armored class, may be readily handled. The fulfillment of these requirements leaves room for some diversity in methods, especially in details, but the examples of chamber construction shown in Figs. 1 and 3 are typical, each in their kind, of good ordinary practice. Manholes on these lines have been built by the writer, and in each case they have been entirely free from trouble.

Fig. 1 shows in diagram the construction and method of setting of a small street chamber built up of cast-iron sections, bolted together at the flanges and rust-jointed. It will be noted that the bolting is done on the outer side, the idea being to give a smooth interior. The use of iron renders the percolation of water or gas impossible, and the only vulnerable portions are the covers and ventilators. The chamber measures, internally, 10 by 7 by 6 feet, and is set upon a block of concrete ten inches thick. The iron is painted with an anti-rusting compound and the sides are surrounded, as shown, with about twelve inches of puddled clay, filling up the space between the walls and the sides of the hole. The chamber was set slightly out of the level lengthwise in order that water, should it find its way in, would accumulate in one place. On the top is a thickness of concrete upon which the bricks and paving stones are bedded, and the cable boxes at each end are also based on a concrete block. Ventilation is provided for by two boxes with perforated lids set in the sidewalk and connected respectively with the top and bottom of the chamber by six-inch pipes. The cowls over the ends of these effectu-

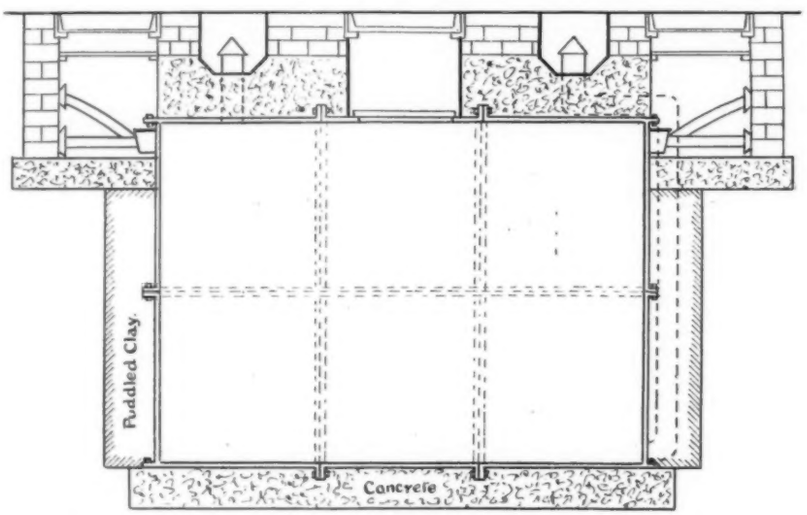


FIG. 1.—CONSTRUCTION OF CAST-IRON UNDERGROUND CHAMBER.

ally prevent water or dirt entering the pipes, and the ventilating box itself may if necessary be piped to the main drainage to keep it clear of water. This is found to be necessary only in very bad positions and in the ordinary course the box is not likely to be flooded. The manhole, which in this particular case is fitted with duplicate covers, may also be piped to the drain if the outer cover cannot be relied upon to keep water out, but in this connection it is necessary to bear in mind that some road drains, owing to their construction, are liable to be flooded in bad weather, with the result that water finds its way through all connections and promotes the evil the drain was installed to prevent. Before connecting up to a drain it is therefore necessary to make full inquiries as to whether it is subject to flooding in heavy rains.

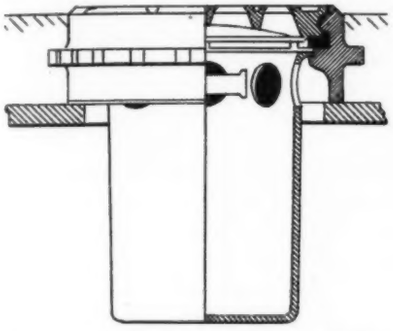


FIG. 2.—VENTILATOR FOR MANHOLES.

The provision of a ventilator which, while giving free egress to air, will not permit of the influx of water when set level with the road has always been a difficulty of underground-chamber construction. Fig. 2 illustrates in half section a type of ventilator which has been very successful and is both simple and cheap. It is built of iron and is 8.5 inches deep by 7.25 inches across the surface. The bucket projects into the chamber or box, and the course of the ascending air is up the opening surrounding the bucket, through the holes in the top of the latter, and then around the edges of the dome-shaped baffle, from whence it flows out through holes in the cover. Water and dirt are caught by the bucket which is provided with a handle, so that it may be lifted out periodically and emptied.

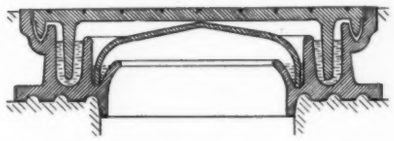


FIG. 4.—TRIPLE-SEAL MANHOLE COVER.

Iron manhole construction is essentially soundproof and waterproof, but it is somewhat expensive, and a cheaper brick structure is often preferred. A good design is shown in Fig. 3. The foundation, as before, is of concrete, but it is set at a slope of about one inch in three feet, and at the lower end is a small sump for collecting any slight amount of water which may find its way in or be condensed on the walls. These latter are of brick about fourteen inches thick. The roof is built up of concrete, supported by five-inch girders. No brickwork chamber is ever thoroughly waterproof and it is necessary, as was done in this instance, to insert a damp-proof course. This may consist of sheet lead or asphalt, care being taken in either case that joints are properly wiped. A layer of cement will often suffice, but in very wet locations more thorough means must be taken. The ventilating pipes in this particular chamber were carried into 3.5-foot standards erected on the curb so as to obviate all danger of flooding. From the point of view of appearance it is generally desirable that these should be of equal height, but if possible it is better to arrange for the outlet pipe to be carried higher up than the inlet in order to improve the draft. To this end a fan is often introduced, and considering its beneficial effect in reducing the temperature it is well worth while.

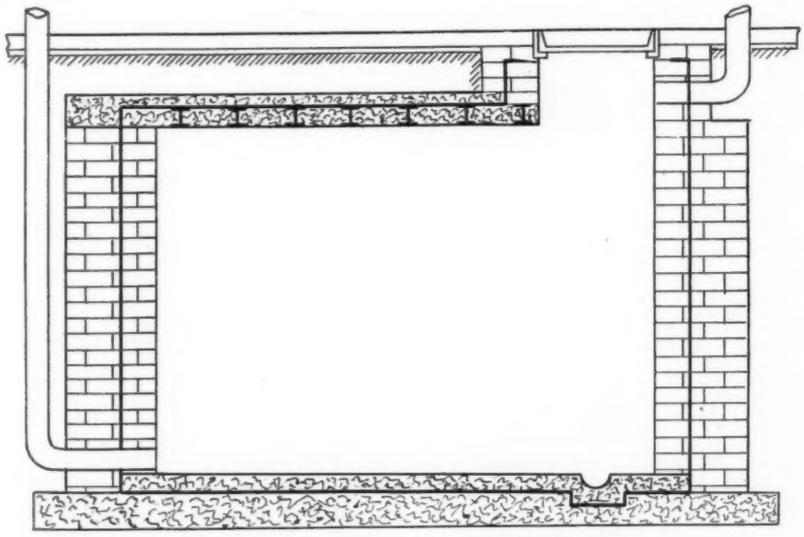


FIG. 3.—CONSTRUCTION OF BRICK MANHOLE.

The dimensional design of a manhole is influenced chiefly by the number and size of the transformers it is to contain, and to avoid structural alterations at a later date it is well to keep in mind future possibilities. The size of the manhole cover will, for instance, be influenced by that of the largest transformer ever likely to be installed. Frequently the manhole cover is made of very ample size to allow of easy handling of the equipment, and a smaller opening arranged for in the cover to be used only for obtaining access to the pit.

There is a good deal in the design of manhole covers, which, if improperly fitted, will be of little use to keep out water. For bad situations a cover upon the lines of that shown in section in Fig. 4 will be found very satisfactory. It provides a triple seal of glycerine, oil, or any suitable filling, and condensation forming on the inner dome trickles down to the seal where it is caught. The frame is bedded in cement in the ordinary way, the three grooves in its base serving to prevent the infiltration of water which is always liable to take place in the usual plain based frame.

Condensation or sweating will always occur in underground structures, no matter how waterproof they may be and, needless to say, it is highly undesirable in the presence of electrical apparatus. Painting will minimize it, but by far the best preventative is a layer of granulated cork, painted and applied in the manner usual in the case of ships' steel bulkheads. Brickwork is a great sinner in this respect, and it takes a long while for the initial dampness to dry out. Hence, it is well after a brick chamber has been completed to dry it

out as thoroughly as possible by keeping up a coke fire for several days. Ultimately, the normal working heat of the chamber and the circulation of air through the ducts will keep the walls dry, but in the first instance special precautions should be taken. It is in view of the possibilities of condensation that switchboards should never be set hard against a wall; there are numerous instances, particularly with iron chambers, of grounds occurring through a film of moisture that has trickled down the walls and over the surface of the board of the contacts.

Considerations of safety should largely influence the design and equipment of underground manholes which of necessity must be restricted in size. In addition to the usual precautions common to all electrical installations the manhole should be so arranged that the space in the immediate vicinity of the bottom of the ladder is quite free from all apparatus, particularly live contacts. Very often this is not the case, and a person descending the ladder is in such close proximity to some part of the equipment that a false step may prove fatal. Further, grounding of all metal work, such as transformer cases, iron ladders, etc., should be most carefully carried out by means of a proper earth connection instead of in the perfunctory manner which has so often given rise to mishap. Another point that is frequently neglected is stand-by lighting, although in the event of a breakdown this is most necessary. The normal working heat of the chamber is generally too high to allow of candles being stored, and lamps rapidly become useless through evaporation of the oil. The only effective means is to keep a small portable-battery lighting set in each chamber and, although recharging is troublesome, the convenience of having a good light at hand in a breakdown is very great.

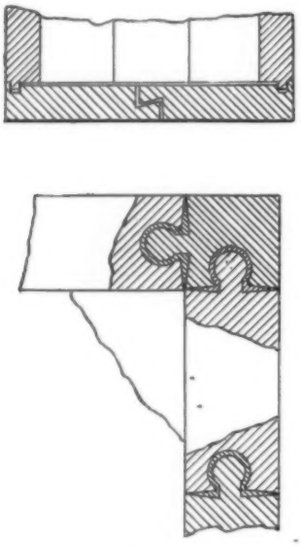


FIG. 5.—METHOD OF BUILDING UP STONEWARE JUNCTION BOX.

In the case of draw-in boxes the presence of gas is more to be feared than water, and yet it is seldom that any really adequate ventilating arrangements are provided. Junction-box explosions are a serious matter and there is no doubt they are increasing in frequency. Where the infiltration of gas is to be feared, as is the case in most cities of any size, it is open either to make sure of keeping it out by employing a thoroughly impervious structure or to provide proper ventilation. As a matter of fact, a combination of the two is the better, since, however gasproof the walls of a box may be, there is always the possibility of leakage at the cable glands. Also, it is desirable to take into account the highly inflammable gas which may be generated by heat from the insulation of cables, especially if these are of the bituminous class.

The simplest type of junction box, namely, that consisting of brick or concrete walls, a waterproof cover, and a dry rubble bottom, is limited to locations where there is no fear of gas. Of late years boxes of a much better construction have come into use, and two good types are illustrated in Fig. 5 and 6. The former drawing shows the essential details of a system recently patented by an engineer of the London County Council. The box is built up of slabs of artificial stoneware tongued and grooved in the manner shown, and the joint in the floor is made long and mechanically sound by means of a half dovetail. The upper drawing also shows the method of joining the walls to the base, thus insuring gas-tightness by aid of a water seal. This does not dry up and makes a sound job of what is generally a difficult joint to render thoroughly impervious. When the slabs are fitted into place the joints are grouted with Portland cement and the box is thus made solid to all intents and purposes. Where the cables are brought in, side slabs divided horizontally and shaped to fit round the cable are employed, the joint being made tight by cement poured through a hole provided in the upper slab. In addition to its imperviousness to gas and water, a great feature of this construction is the ease and celerity with which a box can be built. The chamber shown in Fig. 6 is a good example of the impervious and ventilated type. It is lined with tiles set in concrete, the former being shaped as shown to key them into position. The ventilating box can, if necessary, be connected to the sewer, but it is preferable in every way to employ a ventilating post some 3.5 feet high and thus avoid all troubles with water.

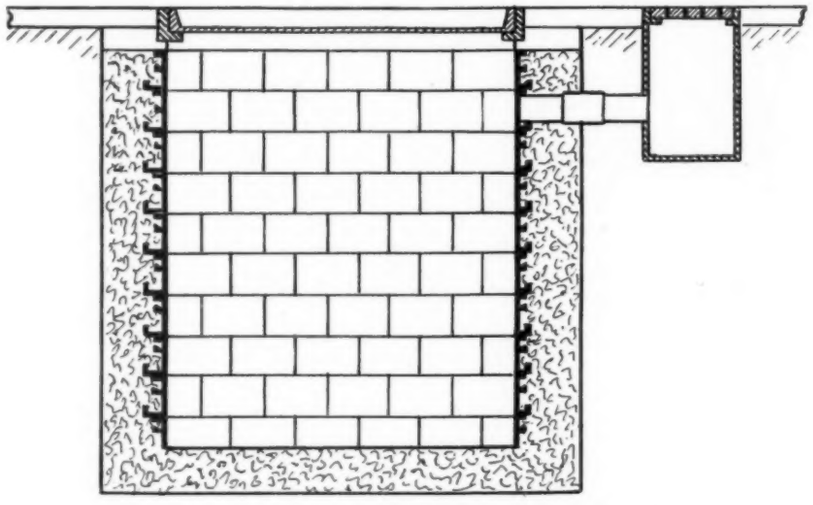


FIG. 6.—TILED AND VENTILATED JUNCTION BOX.

Fusion by Earth Currents.

A case of fusion of pipes by earth currents is related in *The Electrician* by W. R. Rawlings. The pipes in question were an iron gas pipe and a lead water pipe, and both pipes were fused at the point of contact.

Hydroelectric Plants in Norway.

At a meeting of the Faraday Society on May 2, A. Scott-Hansen, of Christiania, read a paper on "Hydroelectric Plants in Norway and Their Application to Electrochemical Industry."

The author said that the physical configuration of Norway is remarkably favorable for the utilization of the large number of waterfalls to be found on the seaboard of the mountain chains which almost cover the country, and through whose valleys the enormous quantity of water precipitated from the western and southeastern sea breezes finds its way as rivers flowing down to the sea. In the winter the rainfall takes the form of snow, so that the volume of water brought down by the rivers is at its greatest from May to July, when the snows melt on the mountains. To make use of the water power, storage is, therefore, necessary, and for this the nature of the country is peculiarly adapted, being covered with lakes that have very contracted outlets and which can be easily converted into storage reservoirs by damming. Thus in the watershed of Skien the natural water power of 50,000 horsepower has been increased to an available horsepower of 375,000, while the Mösvand reservoir has increased the water power of the Rjukan factories from 30,000 to 250,000 horsepower with a capital outlay of only about $410,000.

The total water power in Norway has been estimated at from five to seven million horsepower, but as much of the country has not been hydrographically surveyed, this is probably too low an estimate. The power stations can supply power at from $6 to $10 per kilowatt-year, and in some cases even for less; and as the quantities available are as high as from 50,000 to 100,000 horsepower for a single fall, the conditions are ideal for the development of electrochemical and electrometallurgical industries. Many such industries have already reached an advanced stage of development. Thus nearly 180,000 horsepower will be utilized this year in the manufacture of nitrates of lime, soda and ammonia from the air by the Birkeland-Eyde process and the Badische Analin und Sodafabrik Company's process; about 60,000 horsepower are employed in the manufacture of calcium carbide, and other electrochemical and electrometallurgical industries absorb at present some 20,000 horsepower. Now that a suitable electric furnace—the Grönwall—has been designed for the smelting of iron ore, a furnace that has yielded excellent results on a practical scale, electric iron and steel smelting is likely to develop largely in the near future, for Norway possesses extensive deposits of iron ore. Three plants, aggregating 16,000 horsepower, with provision for increase to nearly 60,000, are now being erected at Hardanger, Arendal, and Tinfoss. Other ores, notably copper, nickel, zinc, will also possibly be electrically smelted at no distant date.

Peat Powder for Fuel.

A number of practical tests, undertaken at various places in Sweden, distinctly point to the fact that peat powder can successfully compete against coal as boiler fuel. At the Sahlström factory in Jönköping several thousand tons of peat powder have been used as boiler fuel with the result that one ton of peat powder made from good peat has been found, if properly utilized, to be equal to one ton of good English coal. Powder made from second quality peat, naturally, is a less efficient fuel, but still a perfectly serviceable one, which is a point of considerable importance. Experience has also shown that it does not pay to carry the "refining" process too far, and the best remunerative result is obtained by only reducing the percentage of water to 15 per cent. The powder will be cheaper but also slightly less efficient than if the contents of the water was reduced to 12 or even 10 per cent. Mr. Ekelund, who for years has carried on experiments in this direction, sums up the results of his experience in the use of powder obtained from medium peat, with 15 per cent water, as follows: 1.2 ton is equal for boiler fuel to 1 ton best coal, and for peat powder made from good peat the value is about equal to that of the best coal, ton for ton, under working conditions. Peat powder can be produced at $2.15 per ton, inclusive of interest and sinking fund, whilst coal delivered to the railway in Swedish ports at present costs $3.95 per ton, and the inland price will average $4.50 per ton. The Swedish Union of Boiler Owners has commenced experimental tests with the new fuel, and the leading Swedish State expert in this matter also speaks very favorably of the Ekelund peat powder, stating unhesitatingly that, in his opinion, peat powder as boiler fuel excludes all competition on the part of coal. Peat powder is also, by way of experiment, being used for electric ore-smelting, and very favorable opinions as to its value have also been expressed by a mining engineer.—*Engineering.*

Reinforced-Concrete Poles for Lighting Circuits in Germany.

Poles of reinforced concrete for both high- and low-tension electric circuits are finding an increasing demand in Germany, and Karl Roessle, in a recent number of *Beton und Eisen*, describes those used for the Hohenzollern Sportpalast, a large skating rink in Berlin. Because of the decay of wooden poles, the high price of iron poles and the constant attention required for their maintenance, the management decided to employ reinforced concrete.

The simplicity of the system used, the Wolle, made it possible to mold all poles in wooden forms at the site of the work. Both the making and the erection were accomplished without the use of machinery, and the initial cost was comparatively small, being about one-half that of iron poles.

The poles were materially lightened by adopting a tapered section, reducing the size from about 1.2 by 1.8 feet at the bottom to 0.46 by 1 foot at the top, and at equal distances for the greater part of the length holes were cut through, which not only reduced the weight, but also presented less surface for wind pressure in the direction of the smallest resisting moment.

The highest of the poles, which curved over at the top, was about 44.3 feet, of which 8.2 feet was in the ground, which brings the arc lamp about 32.8 feet from the ground surface. Heavy signs, suspended between posts, increased the bending moment at the ground level. It was necessary to provide for this. Therefore, a flat iron plate of rectangular cross-section, about 3 by 3.5 feet, was placed on either side between the ground and the pole extending from the surface of the earth downward. The greatest difficulty experienced was in placing the conduits in which to run the electric wires.

These concrete poles were erected by means of wooden shear-legs 29.5 feet in length, and, although the total weight of each pole was approximately 9,259 pounds, they were raised without injury when but fourteen days old.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

LESSONS FROM THE PEOPLES GAS BUILDING AT CHICAGO.

BY ALBERT SCHEIBLE.

Ever since the Peoples Gas Light & Coke Company, of Chicago, began planning its new twenty-one story office building, there has been a good deal of speculation among the electrical as well as the gas fraternity in regard to the extent to which gas might successfully replace electricity in lighting such a building. For, while gas has been introduced only to a very limited extent into one after another of the skyscrapers which have been rising in Chicago, this might be attributable to the evident backwardness of the gas interests, who had not until recently shown a marked effort towards solving their illumination problems along engineering lines. Only during the last few years have the electrical competitors of the gas company at Chicago been conscious of sufficiently serious work being undertaken in connection with gas-lighting installations to command their respect, and naturally the new gas building offered fine opportunities for a show equipment. Figures as to the amount spent in making the lighting system of this building a notable one would be interesting in comparison to the electric-light equipment of similar buildings, though a considerably larger expense might be justified in this case, as the evolution of new types of fixtures and of controlling mechanisms must have been costly. While such figures are not yet available, the recent presentation of the lighting features of this building before the Illuminating Engineering Society by the gas company's illuminating engineer, Charles A. Luther,[1] called attention to points from which some exceedingly interesting conclusions can be drawn.

(1) *Adapting gas to modern buildings requires radical changes.*—Most of the large buildings in Chicago already bear testimony to the inadequacy of the familiar gas fixtures. Mr. Luther's work showed that with serious stndy and with some decided departures from the crudely conventional methods which have long characterized gas lighting in most American cities, it may be possible to use gas instead of electricity for the adequate lighting of even a monster office building, that under consideration being a corner building 270 feet high (plus basement and sub-basement) with frontages of 196 and 171 feet on the two streets. But to secure a lighting equipment that would stand comparison with that of other large buildings, the gas company had to adopt new methods and new fixtures. The familiar "gas arcs" and the conventional types of chandelier and bracket mantle fixtures which the gas interests are still so persistently exploiting, are all conspicuous by their absence in the company's own building—a belated, although undoubtedly sincere, admission that these older types of lighting equipment are not in the same class with the electrical fixtures used in other buildings.

(2) *Gas fixtures can be thoroughly artistic.*—The beauty of the fixtures developed for use in the different parts of the building and the appropriateness of each type to its surroundings, makes them well worth seeing. Indeed, in harmony of design and in artistic effect, the massive pendent fixtures in the gas company's offices are decidedly in advance of the electric-light fixtures used in other large buildings recently erected in Chicago. If any one doubts it, let him compare the former with those installed in the new City Hall. Each of the latter is a medley of wrought-metal scrolls, cast ornaments and chains with exposed wires, supporting a lantern in which a half dozen carbon-filament lamps are readily discerned as individual and inefficient units. On the other hand, the bronze ceiling fixtures in the new gas offices are pendants in which four tubes give an impression of stability never obtainable by any chain and in which a well chosen diffusing globe hides the source of the light so that the whole globe seems to radiate it. So also, the bracket fixtures show up well in comparison with most electrical brackets, entirely outclassing ordinary gas brackets.

(3) *Fixtures should harmonize with their surroundings.*—The adoption of handsome posts or standards for supporting lamps under the skylight where pendent fixtures of any kind would detract from the architectural effect, as also the half-concealed placing of the ornate outdoor lamps between the columns, shows a determined effort to have every part of the lighting equipment harmonize with its surroundings—a feature that deserves to be studied and emulated.

(4) *Economy of heavy glass globes.*—While the inclosing globes used with tungsten lamps may not be subjected to as severe strains as those used with Welsbach mantles, still the precedent set by the use of extra-heavy glassware might prove a real economy if followed in electric-light practice.

(5) *Single-lamp units superior to clusters.*—Where tungsten lamps are used in clusters, the clear lamp bulbs and the slender filaments interfere so little with the rays of light from the other lamps that the resulting total of light is substantially the sum of that of the individual lamps. With gas clusters, however, the mantles are not only opaque but bulky as well and, as the light from each cannot penetrate the others, the total measured candlepower of the so-called "gas arc" will not equal the sum of the candlepowers of the mantles used in the same unless steps are taken to increase the gas combustion. The latter can be done by adding a tall stack or chimney above the inclosing globe, which is usually out of the question where artistic effects are desired; hence, to secure the latter for the company's own offices and building front, Mr. Luther adopted lamps having a single high-candlepower mantle.

1 For a brief abstract of this paper, see page 1055 in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for May 27th.

(6) *Boosting the gas pressure makes it more efficient.*—Not satisfied with using gas under the same conditions under which it is supplied to its customers, the gas company has raised the gas pressure for the single-mantle lamps used in and around its main office, so as to use the gas more efficiently. This is done by booster pumps in the sub-basement of the building, driven by electricity from the rival electric light company's circuits, the result being at least twice as high a maintained candlepower for a given gas consumption. However, the various offices in the building(in which the tenants pay for the gas) are supplied with the less efficient low-pressure gas and with stackless three-mantle burners, so that only the gas company itself is as yet profiting by the more economical units.

(7) *High-pressure gas mantles must be lighted slowly.*—In thus using the gas at an abnormal pressure, the rate at which it is admitted through the burner when the lamp is at full candlepower is correspondingly high. If the lamp were lighted at full capacity, the resulting explosion might blow the mantle to pieces. To avoid this, each burner is equipped with a thermostatic valve which at first is open only enough to give a non-incandescent flame, but which gradually opens so that the mantle begins to give light in about three-quarters of a minute and reaches its full candlepower in about 1.5 minutes.

(8) *Non-electric gas switches are cumbersome.*—Outside of the booster equipment, water pumps, refrigerators, etc., which are electrically operated, there seems to have been a studied endeavor to eliminate the use of electrical devices in this building. The motor-driven equipment, being in a sub-basement, is not seen by the average visitor to the building, and in all probability gas engines would have been substituted if it were not for the insurance requirements, the vibrations due to such engines and the increased attendance usually required by them. For turning the lights on and off, electromagnetic switches have been avoided, though a variety of types has long been on the market. Instead of turning the handle of a switch, the attendant takes a pump from his pocket, inserts the nozzle into either the "on" or the "off" tube in an operating cabinet, located like a wall-switch box, and pumps the valve into action. Owing to the thermostatic controlling device, the lamp does not instantly show the light, as is done when turning a switch for an electric lamp. To make sure that the system is in good operation, the high-pressure gas man must take time to apply his pump and then wait a minute and a half. In some classes of service this may not be objectionable, but for store use where a merchant wants lamps in rarely used parts of his establishment, its popularity would be doubtful. Fancy a clerk as saying: "Have a seat, madam, while I get a pump and I will have light for you in a few minutes."

Just how dependable this pneumatically controlled system will be in prolonged operation remains to be seen. In this case a double-action tube arrangement has been installed for each lamp, so that each can still be operated "if for any reason one of the tubes becomes stopped up or broken off from any cause whatever." Then a specially designed, collapsible ladder-wagon (a sort of trolley repair wagon with castors instead of wheels) allows the attendant to make any needed adjustments and to clean the globes regularly—a facility which might be worth copying in some electrically-lighted buildings.

(9) *Gas consumed by pilot flames is not a negligible quantity.*—Any building of this size will warrant a careful and trained attendance which could not be expected of the smaller consumer, and with the extra-heavy globes adopted for the lamps, the number of outages should be small. So also, the leakage of gas due to the blowing out of pilot lamps should be rare, particularly as the pilot burners have been specially designed to reduce this occurrence. Those who have heard the common claim that the pilot flames in gas lamps consume almost too small an amount of gas to be measured, will be interested in noting that this progressive gas company does not believe the pilot consumption to be such a negligible factor. Indeed, Mr. Luther is proud of having secured new tips for the pilot flames which are said to reduce their consumption from one-quarter or even one-half cubic foot of gas per hour for each burner, to one-quarter cubic foot for a three-burner fixture. Even this reduction would mean six cubic feet of gas for twenty-four hours for each pilot flame and for the 4,680 pilot flames already burning in the incomplete building, the resulting consumption of over 28,000 cubic feet per day is certainly not a negligible amount.

(10) *Ceiling plates required for lamps near ceilings.*—The blackening of ceilings over gas fixtures, due partly to the high flames caused by burning the protecting film of collodion off the mantles and partly to the dust carried up by the strong currents of hot air, has always been a vexed point in discussions as to the advisability of using gas. In the tenanted offices of the Peoples Gas Building a happy solution was found by placing a large beaded disk of white enameled steel on the ceiling over each of the cluster lamps. As the fixtures thus used are of a semi-indirect type, the use of such an enameled diffusing plate would be justified. However, Mr. Luther, in his closing words, volunteered the information that "those plates were not put on the ceiling for reflectors, but were put there as collectors, and when the maintenance men go around through the building on their weekly trips they wipe those reflectors off." Unfortunately, the dust-conveying currents of hot air do not confine themselves to these collecting disks, so that even in a new building the discoloration of the ceiling immediately around the cleaned disks implies that the disks offer only a partial solution of the trouble.

(11) *Gas will provide ventilation if ceilings are specially designed.*—One of the surprises of the building is the fine ventilation of the cigar booth located at the junction of the corridors on the main floor, a room with solid walls on two adjoining sides and wide openings into the corridors on the other two sides. The absence of windows and the necessity of burning artificial light all day would make such a room difficult to ventilate even without the cigar smoke and in this case the use of electric fans was tabooed. To draw the air out of the room the latter was fitted up with a false ceiling sloping from all four sides up to a central opening in which a gas lamp is mounted, so that the smoke is drawn through the lamp with the air needed for the latter and exhausted through openings above the false ceiling into the corridor. Of course, the heat which produces these effective air currents is also present in the other gas lamps scattered through the building, and by providing more of the funnel-like sub-ceilings these could also be supplied with artificial ventilation without the use of fans.

(12) *Efficient gas at present for the company's own use only.*—The special burners and operating devices needed with the high-pressure gas (raised by the electric booster pumps from the ordinary 3.5-ounce pressure to a delivered

pressure of two pounds) have been installed only for the company's own main office and for the building-front lighting, the equipment for all tenants being for the usual low-pressure service; hence, the use of the more efficient and, therefore, more economical single-mantle high-pressure units is limited to the company itself, even in its own new building.

Whether the company will extend it more generally through the building (at a heavy expense for replacing the newly installed low-pressure equipment) remains to be seen, but its extension through the city as a whole is certainly far off. Such a general boosting of the gas pressure would render all the present burners obsolete and even if the consumers were willing to purchase new lighting fixtures, the installing of the high-pressure service would take a long time.

That many consumers should install electrically driven equipments for improving the efficiency of gas for their own use (of course, changing all burners and installing slow-acting switching devices for use with the high-pressure gas) is hardly likely, for what gas solicitor would want to tell a prospective customer that the gas furnished by his company requires a small electric plant to make its use more economical? Consequently, the gas company at Chicago seems to be proving by this fine equipment that its hundreds of thousands of customers are not being supplied with gas at its maximum lighting efficiency, such a higher efficiency and economy being available only for the gas compnay's own lamps!

Whether a saving in the lighting costs due to the use of such high-pressure gas at the reduced price of gas (which has been made a political issue) would compensate for the inability to use fans and other electrical conveniences, is not a pressing question of the immediate future.

For the time being, however, the electric-lighting fraternity has really something to learn on the artistic side from this notable equipment and electrical visitors to Chicago may do well to inspect the Peoples Gas Building so as to see what a gas company can do for its own use when not limited by the low pressure at which it is supplying gas to the general public.

Street Lighting in Dayton.

The business section of the city of Dayton, Ohio, has been supplied with a scheme of lighting which is giving much satisfaction, as the details have been carefully worked out. The poles which were selected were designed jointly by representatives of the Chamber of Commerce and the Dayton Lighting Company, and were supplied by Kramer Brothers, a local firm of foundry-men. They are illustrated in Fig. 2. The top of the pole is surmounted by a 100-watt Mazda lamp, while the side arms carry 60-watt lamps. All the lamps are illuminated until midnight, after which the 60-watt lamps are extinguished, and only the 100-watt lamps continue to burn until morning. The hours of operation are governed by the city schedule, which requires operation for approximately 4,000 hours per year.

There are in all thirty-three blocks or approximately three miles of streets equipped with the new posts. There are twelve posts per block, spaced eighty feet apart, and at street intersections there are eight posts. The total number of posts is approximately 400.

FIG. 1.—STREET LIGHTING IN DAYTON, OHIO.

The Dayton Lighting Company supplied the installation complete, and has a five-year contract with the city on the basis of $55 per post per year, including maintenance. The appearance of one of the streets at night is well shown in a photograph which has been reproduced in Fig. 1.

New York Section, Illuminating Engineering Society.

The final meeting of the present season was held by the New York Section of the Illuminating Engineering Society on the evening of June 8. As a preliminary matter of business, the annual election of Section officers was held and resulted in the choice of Bassett Jones, Jr., as chairman; A. J. Marshall, re-elected secretary; H. Thurston Owens and Dr. H. H. Seabrook, managers.

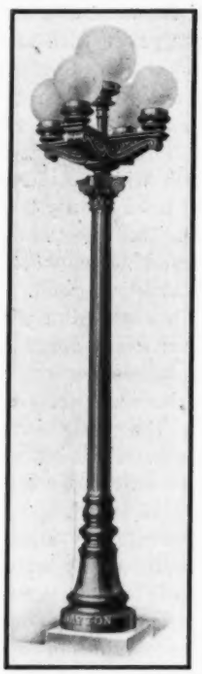


FIG. 2.—DAYTON LAMP-POST.

Sydney W. Ashe then presented in abstract two papers entitled "A Corporation Graduate Course in Illuminating Engineering" and "Notes on Comparison of Illuminants."

CORPORATION COURSE IN ILLUMINATING ENGINEERING.

Mr. Ashe's first paper described a course of lectures given to a class of college graduates that had entered the employ of the incandescent-lamp department of a large electrical manufacturing corporation. These men worked in different parts of the factory and in the development laboratory and at first devoted an hour each day to these lectures; later the lectures became less frequent. There were 69 lectures in all that were delivered by prominent men both in and outside of the company's organization. The lectures were in six groups as follows: Commercial, including largely salesmanship, 19; theory of illumination, 17; types of illuminants, 13; production, 3; central-station practice, 7; general, historical, etc., 10. While the course is still in progress, its results are believed to be gratifying to both company and men.

COMPARISON OF ILLUMINANTS.

In his second paper Mr. Ashe discusses a number of bases of comparison of illuminants. One has been in terms of the actual lumens emitted which is manifestly unfair to many lamps having a distinctly downward distribution. Again lamps have been compared according to their particular usefulness, which recognizes inherent advantages of some types to the discredit of others. He recommends for general use that illuminants be compared on their average candlepower performance throughout life, as this is what the consumer pays for and moreover it takes cognizance of all the variable candlepower characteristics of the illuminant. Mr. Ashe then discusses the characteristics of various classes of lamps. The average candlepower performance of tungsten lamps is 94 per cent of the initial. With gas lamps, particularly mantle lamps, the results are very variable, due to a variety of conditions; the author considers 70 per cent as a conservative average performance; he also shows the importance of including the consumption of pilot flames. Discussing mercury-vapor lamps at length, he arrives at 75 per cent and 61 per cent as the respective performance values of alternating-current and direct-current tubes. Inclosed arc lamps he rates at 78 per cent and 6.6-ampere magnetite arcs at 90 per cent. The paper includes a large table of comparative data on various types of arc lamps.

The first paper was not discussed, but the second stirred up a veritable hornet's nest of criticism of many of its points.

Mr. Evans stated that most of Mr. Ashe's data respecting mercury-vapor lamps agreed with those of the manufacturers, but in some cases results were referred to types of lamps that have not been in use for several years. The tests were made on individual tubes only and are probably not representative. There should be little difference in candlepower depreciation between alternating-current and direct-current tubes. There is no "smashing point" for mercury-vapor lamps; some have given a life of 56,000 hours. The main claim for these lamps is the improved visual acuity attainable by their use.

Preston S. Millar said there is no question but that the total flux of light is the only possible basis of comparison of illuminants considered as light producers. Others bases of rating have been advocated chiefly by manufacturers of particular illuminants that would be benefited by such a method of comparison. A co-efficient of utilization for each illuminant and for a specific service could then be added as a supplementary rating, but great care would be necessary in restricting such co-efficients to their proper use. The author's suggestion of average candlepower performance throughout commercial life is fair, but raises the practical question of what is the commercial life. Mr. Millar questioned the accuracy of many of the data in Mr. Ashe's paper, particularly those respecting arc lamps.

Norman Macbeth declared that numerous errors had been made in interpreting data attributed to him. He questioned the accuracy of the performance of gas lamps and agreed in general with the remarks of Mr. Millar.

G. H. Stickney objected to the candlepower curve that was shown for inclosed arc lamps. These frequently show an increase above initial candlepower. Respecting the comparison of illuminants in general, he favored the total-lumen basis supplemented by giving the lumens in particular zones where the light is of greatest utility.

S. L. E. Rose explained the details of some of the tests referred to in Mr. Ashe's paper and verified the accuracy of his general results. These were checked both at Lynn and at Schenectady and agreed very closely.

Others who discussed the subject were Messrs. Fisher, H. T. Owens and S. G. Rhodes. Mr. Ashe then closed the discussion by defending the results he had given. These were all obtained from very careful tests in some of the best equipped laboratories of the country. He agreed with Mr. Stickney in placing emphasis on other points as well as efficiency.

New Form of Arc Lamp.

At a meeting of the French Academy of Science recently a small electric lamp was exhibited by Urban and Feige, in which the arc is maintained at an extremely low pressure between electrodes of tungsten and mercury. The light is quite white and very close in appearance to sunlight. The consumption is 0.45 watt per candle.

The lamp operates on twelve volts, which makes it unsuitable for ordinary circuits. It is hoped, by using an inert gas instead of a vacuum in the lamp, to increase the resistance and suit it to standard voltages.

The total investment in electrical undertakings in Great Britain exceeds $2,000,000,000.

TELEPHONY—TELEGRAPHY, and WIRELESS.

MACHINE TELEGRAPHY.—I.

BY DAVID E. GRAY.

The constant and ever increasing tendency in America is toward the substitution of machine processes for manual and mental effort. Of course the same condition obtains in other countries, but not to such an extent. The scarcity rather than over-supply of laborers and artizans and the rapid growth of the nation have greatly stimulated the invention of all kinds of labor-saving devices. Today almost everything from digging ditches to mathematics is done by machinery.

In most instances the introduction of mechanical or other improved methods to an art has occurred some time after it has been well established. Accounting was practiced centuries ago, but the adding machine is an invention of recent years; grain was reaped as far back as the beginning of civilization, but an American invented the reaper; and thus we might go on down through almost the entire list of arts and industries. The electric telegraph, however, is one of the exceptions.

Curiously enough the first instrument Professor Morse constructed was what is now termed an automatic telegraph. The message was prepared for sending by setting up metal type, or templets, in a wooden rule. A wire yoke mounted on one end of a wooden lever dipped into two small mercury cups and thus formed the connection between the battery and the line. The other end of the lever, which was normally depressed by a weight, carried a small projection on its lower side. When the type were passed under the weighted end they imparted motion to the yoke corresponding to their shape and thus determined the character of the electrical impulses sent to line. The message was recorded at the receiving end on a strip of paper and was similar in appearance to the modern cable message as produced by the siphon recorder. This instrument was exceedingly crude and of no commercial value.

His next device was a step away from the automatic idea. A simple key was substituted for the type and lever in the transmitter. The receiver was a recording instrument which embossed the characters on a strip of paper. The armature of the magnet made a clicking sound with each stroke and the operators soon become so accustomed to it that they could read the message without looking at the tape; whence the sounder. Thus we see that the telegraph as developed by Morse took the exactly opposite course from most arts.

Other inventors, however, who were attracted by his success, followed the traditional path of development and endeavored to produce instruments that would eliminate the necessity of employing skilled operators. The result was that all the different general types of telegraph systems were introduced during the early stages of the growth of the art.

In this article we shall consider only two classes of instruments as used in America, viz., the automatic and the long-distance printing telegraphs.

The fundamental principles of modern automatics originated in the invention of Alexander Bain, of Edinburgh, who was granted his first patents in England in 1846. The message was prepared by perforating a strip of paper with round and elongated holes to represent dots and dashes. The strip was then passed at a uniform rate between a metal roller and the end of a flat spring, which pressed against it. The roller was connected to the battery and the spring to line. The contact between them was formed through the holes in the paper as it passed along. The receiving apparatus consisted of a metal roller, over which a strip of chemically prepared paper was fed, and an iron stylus resting on the latter. The roller was connected to earth and the stylus to line. The electrical impulses coming in over the line passed through the paper and discolored it, forming dots and dashes corresponding to the perforations in the strip at the transmitting end. The main advantages of this system were the simplicity of the apparatus and the rapidity with which messages could be sent after they were prepared. It was used in America in 1848 and 1849, but was abandoned for want of a means of perforating the paper with any degree of speed.

In 1853, one year after the Bain system had been given up, Siemens and Halske, of Berlin, brought out a three-keyed punch which could be operated at a rate of from twenty to forty words per minute. One key punched a round hole, a second an elongated hole, and the third merely spaced. The device was used in connection with an automatic system which never attained any great prominence because of the slow action of the receiver. A short time afterwards the same inventors produced their polarized ink writer, which was very sensitive and capable of operating at high speed.

In 1858 Professor Wheatstone patented his automatic telegraph in England. This system is very extensively used in both America and Europe and, with the exception of a few minor changes, is the same today as it was when he developed it. With some necessary modifications he combined the perforated tape of Bain, the Siemens punch and the Siemens polarized ink writer. By using both polarities of current alternately, or double currents, as they are called by telegraphers, the speed of transmission was greatly increased. This was accomplished by connecting the middle point of the battery to earth and first one pole and then the other to line. Where impulses of one polarity only are used, considerable time is consumed in discharging the line in order to make the signals distinct. If a negative current is introduced immediately after the ter-

mination of the positive or signalling impulse, the time of discharge is reduced because the difference of potential between the positively charged line and the negative pole of the battery is much greater than between the line and earth. With this arrangement the impulses required to transmit a signal consisting of a dot followed by a dash, would be a positive, a negative, a long positive, and another negative. The last negative terminates the dash distinctly.

In the Wheatstone transmitter the contacts are not formed directly through the holes in the tape as in the Bain, but by fingers whose motions are controlled by them. The paper is fed under a corrugated roller by a clock movement or small motor. The fingers, mounted on the ends of levers, are pressed against the paper under spring tension and at intervals corresponding to the corrugations. If when a finger is raised there is a hole opposite its end, it passes through into one of the grooves in the roller and permits its lever to make a contact below. On the other hand, if there is no hole, the springs yield and the contact is prevented. This arrangement eliminates the difficulty experienced by Bain due to paper dust collecting on the springs and interfering with the formation of a good contact. The tape, instead of having a single row of perforations, has three. Those in the middle are used for feeding the paper positively and are spaced at regular intervals. The two outside lines control the positive and negative fingers respectively.

The receiver consists of a spring or motor-driven mechanism which feeds a strip of paper at a uniform speed over a small ink wheel. This wheel is mounted on the end of the tongue of a polarized magnet and normally stands partially submerged in a small tank of ink and just free of the paper. One side of the magnet is connected to line and the other to earth. A positive impulse coming over the line throws the ink wheel against the paper and a negative withdraws it. The message is recorded in the form of dots and dashes printed on the strip.

The system is very rapid and is widely used on the long lines of the two larger companies. Over the Western Union line from Chicago to San Francisco it transmits messages at an average speed of 100 words per minute. There are five repeaters in this line which slow down the transmission considerably because of the time consumed by their mechanical action. From Chicago to St. Louis it was in daily use for a long time at an average rate of 200 words per minute.

Another automatic that has recently been brought to the attention of the public in a very marked way is the Delany system, which is the basis of the Telepost Company. In theory it is the same as Bain's except that it employs double currents, as does the Wheatstone.

The contacts in the transmitter are formed by two fine, straight, wire springs which press against the tape and make electrical connection with the roller underneath through the perforations. The springs are connected to line. The roller is divided into two parts which are insulated from each other and act like collector rings, the springs corresponding to brushes. The two parts are connected to the poles of the battery, or other source of power, respectively. The holes in the tape are about one-sixteenth inch in diameter and the length of the mark recorded on the receiving strip is determined by their relative positions. For example, a dot is represented by a hole on the side which passes over the positive, or signalling part of the roller, and another immediately opposite on the negative or clearing side. The negative brush is so mounted that its point rests on the paper one unit of distance behind the point of the positive brush. Therefore the positive contact is made first and the clearing current is not sent to line until the tape has moved one unit. A dash is formed by a positive hole and a negative one two units behind it. In this case the clearing current does not go to line until the tape has moved three units. From this it will be observed that the battery is in contact with the line only during the first part of the signal as recorded at the receiver and the latter part is actually formed by the discharge of the line. This is what is known among telegraphers as "tailing," the length of the tail being determined by the time at which the clearing current is introduced.

In the receiver a strip of chemically prepared paper is fed between a roller and a fine wire stylus and a record is made in the same manner as in the Bain system. The feeding of the paper in both transmitter and receiver is controlled by motor-driven mechanisms. An important feature is the automatic starting and stopping of the mechanism in the latter.

According to the authorities in charge of the Telepost Company's office at Chicago, the Delany system operates from there to St. Louis at a rate of about 200 words per minute, and at times when the line conditions have been right it has attained a speed of 1,000 words or more. This great speed is made possible by the simplicity of the apparatus. The time consumed in energizing an electromagnet and moving its armature is practically all saved. A weak current will produce a record on the tape, therefore the line does not have to be charged to such a high degree as in the Wheatstone system and a shorter battery contact can be used. If the line is not so heavily charged it will take less time to discharge it and the signalling impulses can be transmitted more closely together. On the other hand, with such conditions a system is very susceptible to line disturbances, such as intermittent leaks or induced static charges. These cause a mutilation of the signals and the message has to be repeated. There are also mechanical difficulties to be contended with. In the receiver the paper must be kept sufficiently moist to give good results but not weaken it, otherwise it would break under the strain of being pulled through the machine so rapidly. There must be no vibration in order that the stylus may always be in good contact with the paper. In the transmitter the brushes must be kept free from accumulating paper-dust and their tension must be sufficient to force their points through the perforations promptly but not tear the tape. The speed of feeding the paper must be uniform, otherwise the marks will be of varying lengths and rendered illegible. These conditions apply not only to the Delany system, but to any employing similar means of transmission.

Printing telegraphs may be divided into three classes—synchronous, step-by-step, and selective. The first embraces several of the older machines, of which the Hughes is the best example. The second includes all the tickers and a few of the earlier long-distance instruments. Most of the modern printers are of the selective type.

The first printer that was ever put to practical use was invented by Royal E.

House, of Vermont, in 1846. It was a step-by-step machine and was manually operated. The messages were printed on a continuous strip of paper at the receiving end.

The transmitter consisted of a keyboard made up of twenty-eight keys similar to those of a piano, a drum mounted under the keys, and a make-and-break device mounted on the same shaft with the drum. Twenty-six of the keys represented the letters of the alphabet, one was used for the period, and one for the "space." Radial stop pins on the drum engaged pins on the under side of the keys when the latter were depressed. A wheel, having fourteen teeth, was rigidly mounted on the drum shaft and actuated a lever which made and broke the connection between the battery and the line. A powerful magnet in the receiver operated a slide-valve similar to that of a steam engine. The valve admitted air under pressure to either side of a piston in a cylinder, which actuated an escapement rigidly connected with the type-wheel. The printing was controlled by a dog running over the teeth of a wheel on the type-wheel shaft. When the shaft came to rest the dog dropped between two teeth and released the printing hammer, which forced the paper against the type.

To transmit a character the drum and type-wheel were placed at an arbitrary unison point, the proper key was then depressed and the drum revolved by hand until its corresponding stop pin engaged the pin on the key, which stopped rotation. This sent an impulse over the line for each tooth of the make-and-break wheel included in the angle through which the drum revolved. The impulses actuated the escapement by means of the magnet and air mechanism and revolved the type-wheel through the same angle. Thus the proper letter was presented to the paper tape, which was fed along after each printing movement. Notwithstanding the crudity of the apparatus, a speed of 2,600 words per hour was attained over a line 150 miles long. This necessarily required great skill on the part of the operators.

Although the Hughes printer was not used in America to any extent, it may be well to briefly describe it, as it is the basis of a large percentage of the European telegraphs and is the best example of the synchronous type. It was patented by David E. Hughes, of Kentucky, in 1858, and afterwards improved by George M. Phelps. The apparatus consists primarily of three parts: the keyboard, the revolving contact arm and type-wheel, and the printing mechanism. The form of the message as received and the keyboard are the same as those of House.

The arm is made in two insulated parts, one above the other, which are normally electrically connected by contact points. The upper part, so hinged that its outer end can move vertically and break the contact, is connected to line through a magnet, and the lower to earth. The depression of a key raises a rod so that its end is in the path of the arm. As the latter revolves, its upper part rides over the end of the rod, thus breaking the connection between earth and line, and establishing another between line and battery through the key.

The magnet, which controls the printing mechanism, is of a peculiar design. It consists of two windings whose soft-iron cores are mounted on the poles of a permanent magnet, as in a telephone receiver. Its armature is normally held against the cores by the magnetism and a spring of considerable strength tends to pull it off. If a sufficiently heavy current passes through the windings in such a direction as to decrease the magnetism in the cores, the attraction becomes less than the pull exerted by the spring and the latter moves the armature with a quick positive action. This magnet is extremely sensitive and can be operated by a battery contact of about one-third the length of that required by a Morse. Opposed to this is the disadvantage of having to restore its armature by mechanical means.

To transmit any character, such as the letter A, the corresponding key is depressed and when the arm strikes the rod, which has been raised into its path, the battery contact is made and the printing magnets in both instruments are actuated. As the arm and type-wheel revolve together, the A at the transmitter will be opposite the printing roller at this instant. The same must be true at the receiver, otherwise the wrong letter will be printed. In other words, the type-wheels of the two instruments must revolve synchronously. An adjustable governor, controlling the speed of the driving mechanism, is intended to perform this function. The type-wheel is driven by friction and can be arrested by means of a small lever in such a position that the division reserved for the "space" is opposite the printing roller. The device is so arranged that the printing action releases it again. Thus to establish unison at both ends of the line, the wheel at the receiver is arrested and the "space" key is depressed at the transmitting end.

Electrically the Hughes system is very fast, as only one impulse traverses the line for each character. Contrary to most printing telegraphs, the mutilation of a character does not affect the proper reception of the following one, provided the cause has been removed. The speed, however, is not great because of the necessity of maintaining synchronism and the slow movement of the printing and armature-restoring mechanisms as compared with the electrical action. Its average rate is about thirty words per minute.

(To be continued.)

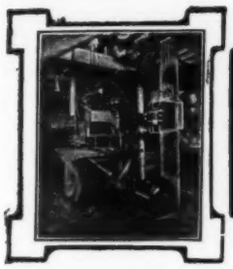
Telephone Train Dispatching.

There are at present in the United States 34,885 miles of railroad equipped for dispatching by telephone, exclusive of roads with circuits of less than 100 miles. This is twenty per cent of the railway mileage of the country.

According to the *Canadian Engineer*, the Canadian Pacific Railway has 3,955 miles equipped with telephones, or 71 miles more than the Santa Fe road, the largest in this country. If the Canadian Pacific Railway's subsidiary lines are taken into consideration, the big Canadian road has an even greater lead on its United States rivals, as the Soo line has 190 miles of telephone wires, which, added to the figures of the Canadian Pacific Railway proper, gives a total of 4,140 miles.

Altogether in the United States and Canada there are 46,077 miles of the system in use, of which the Canadian operates 4,360 miles. The leading railways in this respect are:

	Miles
Canadian Pacific Railway.....	3,955
Atchison, Topeka & Santa Fe...	3,884
Great Northern	3,881
Illinois Central	2,550
Chicago, Burlington & Quincy..	2,383
Chicago, Rock Island & Pacific..	2,248
Pennsylvania Railway	2,137
Chicago, Milwaukee & St. Paul..	1,770
Southern Pacific	1,377
Northern Pacific	1,190
Norfolk & Western	1,060



Industrial Power

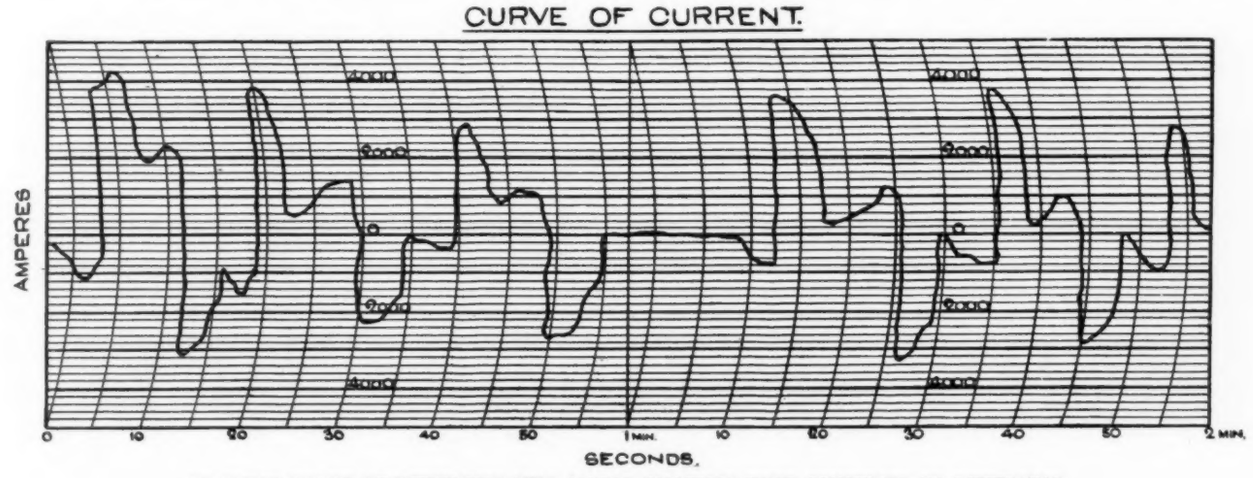
ELECTRICALLY DRIVEN REVERSING MILLS.

BY A. H. BRIDGE.

The electrical installation at the works of Alfred Hickman, Limited, at the Staffordshire Steel & Ingot Iron Works, England, possesses points of special interest. The entire electrical equipment was installed by the Electrical Construction Company, Limted, of Wolverhampton, and the matter was before the courts in London last year in a case in which the firm was sued for alleged infringement of the Ilgner patents. The courts, both at first hearing and on appeal, decided in favor of the company.

The Hickman mills are among the largest in the world; they consist of a thirty-inch cogging mill and a twenty-four-inch bar mill, the electrical equipment comprising two reversing-mill motors and a flywheel-motor-generator set. The plant is stated to contain only equipment in which the variable-voltage generators and the motors operate at 1,000-volts pressure, and in which mills of so large a size are driven by single motors. The driving losses are understood to be considerably lower than those which usually occur in plants of corresponding output, and the space occupied is smaller. The time of reversal for each mill motor does not exceed six seconds from the maximum speed in one direction to the maximum speed in the opposite direction.

The flywheel-motor-generator set consists of one motor, two flywheels and two generators, each generator being in direct electrical connection with its own mill motor. Power is supplied from the central station to the motor of the flywheel set at 460 to 500 volts continuous current. The motor is shunt wound, and is designed to develop 2,000 brake horsepower at continuous working load. The magnetic circuit of the motor is laminated throughout, so that the speed answers directly to the automatic regulator. The generators are both separately excited, and supply current to the mill motors at a pressure of from 0 to 1,000 volts. The efficiency of each of the three machines is 94.5 per cent at full load. Each of the two flywheels is fourteen feet in diameter and weighs twenty-eight tons, the peripheral speed being about 15,400 feet per minute. Each is built of three separate steel castings only. The maximum speed of the set is 350 revolutions per minute, which speed is decreased by means of the automatic regulator to 290 revolutions per minute. For starting the flywheel-motor-generator set, an arrangement is provided which connects the armature of the cogging-mill generator in series with the armature of the motor. This arrangement is economical in current consumption and in time required for starting, and allows a comparatively small starting resistance to be used. The motor of the flywheel-motor-generator set is excited from the 400 to 500-volt busbars, and an efficient emergency electric brake is obtained by connecting its armature across the starting resistance. The speed of the flywheel set is made to vary from fifteen to eighteen per cent below the maximum in order that the flywheels may supply the power required to equalize the peaks in the load. To obtain this variation in speed, the motor of the flywheel set has a resistance in the shunt-field magnetic circuit, the amount of this resistance being varied by an automatic regulator, operated by the current taken by the motor. This regulator is arranged to come into operation whenever the current input rises above or falls below a predetermined value, and is guaranteed to equalize the load on the generating station to within twenty per cent of the average load. The cogging mill is used for cogging two-and-one-half-ton ingots to



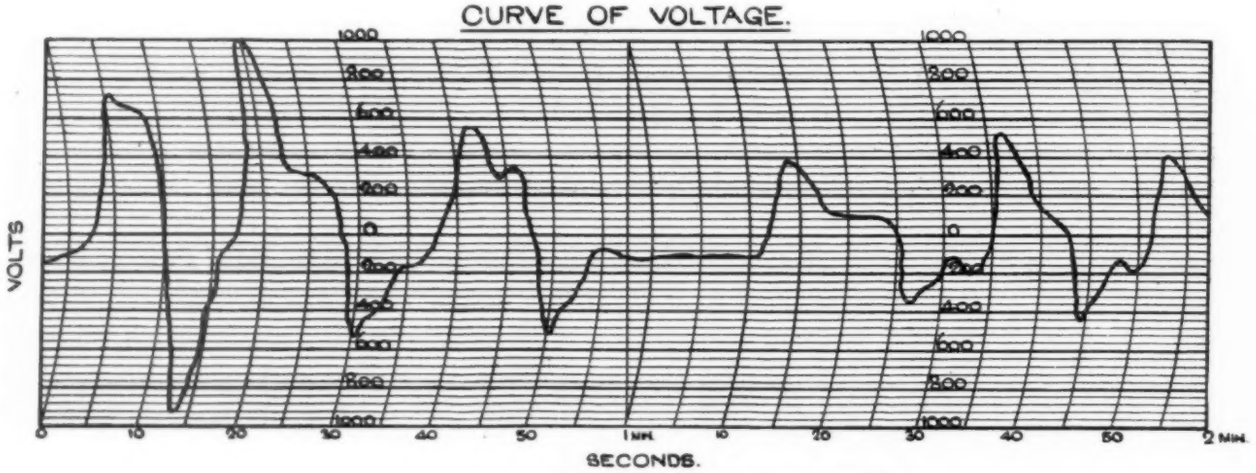
CURRENT CURVE OF REVERSING-MILL MOTOR SHOWING TIME CONSUMED IN REVERSING.

blooms of four-and-one-half to six-inch sections. The motor is in the same building as the flywheel-motor-generator set, and is connected to the rolls through two to one gearing. The motor will develop 4,800 brake horsepower at 1,000 volts for five-second periods six times per minute as a rolling load, and a maximum load of 9,600 brake horsepower for two-second periods once every hour. The speed of the motor is 120 revolutions per minute, at which speed the output is measured, and it is excited from 460/500 volts. This machine was designed to reverse from + 120 to —120 revolutions per minute in six seconds, and this is accomplished in practice. The bar mill contains two sets of housings and rolls, and is built for rolling sheet bars, billets, rounds, angles, etc. The motor is placed in a light building to protect it from dust and damp, and is connected directly to the rolls. The motor will develop 6,000 brake horsepower for five-second periods six times per minute, and a maximum load of 12,000 brake horsepower for two seconds, once an hour. The speed of the motor is 120 revolutions per minute and it is excited from 460/500 volts.

The speed and reversal of the mill motors is controlled by a system similar to the Ward-Leonard system, the voltage of the generators being varied between a positive and a negative maximum. The voltage variation of each generator is obtained by the operation of a single controller at the corresponding mill platform. This controller varies the field excitation of a small motor-driven exciter, which, in turn, varies the excitation of its variable voltage generator. Each mill motor has constant field excitation, and the speed therefore depends upon the voltage applied to the armature. Thus each position of the controller handle corresponds to a definite speed of its mill motor. The controller used does not deal with a current greater than one ampere, and manipulation is easy and there is no arcing. It is claimed that by the above control system only a small amount of energy is lost in reversing the mill, since the energy expended in accelerating the rotating masses is largely returned in the form of electric energy when the speed is decreased.

In order to safeguard the machines circuit-breakers are placed in the main circuits; these breakers are mounted on the main switchboard. Switches which can be operated by the mill driver or by the switchboard attendant are provided for breaking the field circuits of the generators. In addition to these safeguards, the connections are so arranged that it is impossible to excite the generator field unless the field of the corresponding motor has been previously excited. Indicators showing the speed of the rolls and of the flywheel-motor-generator set are fitted at each mill platform, while the speed of the flywheel set can also be read from an indicator on the switchboard. The exciter set consists of two exciters direct-coupled to, and driven by, one seventy-five-horsepower motor. The motor is connected to the 500-volt supply and runs at a speed of 1,500 revolutions per minute. The armatures of the two exciters are respectively connected direct to the field circuits of the two variable-voltage generators of the converter set. The current in the field circuit of the exciters is varied in magnitude and direction by the position of the controller handle. The magnetic circuits of the exciters are laminated in order to obtain the necessary quick reversal of flux. A special type of controller was designed for the control of the live-roll motors.

The typical current and voltage curves of the cogging motor at Hickman's show the quick reversal of the motor in spite of the heavy work performed.



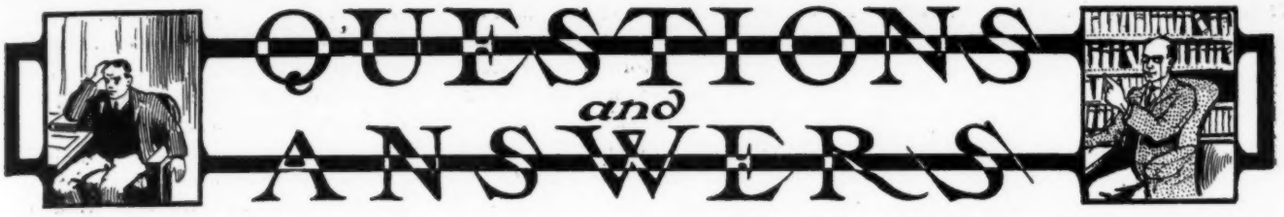
CURVE OF VOLTAGE OF MOTOR DRIVING REVERSING MILL.

Electrically Operated Shears.

A set of electrically operated shears capable of lifting 100 tons was erected on the quay at Aberdeen, Scotland, and was recently described in *Engineering*.

The traversing gear for working the legs is driven by an independent motor of 100 brake horsepower, fitted with a reversing controller and solenoid brake, the latter automatically stopping and holding the motor as soon as the current is cut off. There are two hoisting-winches, one being capable of raising weights up to 100 tons, and the other for weights up to thirty tons, with a very quick lifting speed. These winches are driven through clutches by a 100-horsepower motor, which has a reversing controller fitted with a pilot-switch for regenerative control.

A powerful foot-releasing brake is fitted to each winch for holding the weights, and by means of this brake the weight, when released, is allowed to overhaul the winch, and, in turn, overhaul the motor, compelling the latter to regenerate.



ERRORS IN READING METERS FROM ELECTROSTATIC CAUSES.—In shop tests I was told not to rub the glass on a voltmeter because it would not give a correct reading. But the glass was so dirty from finger marks and oil that I could hardly see the pointer. Was I wrong in trying to clean the glass?—W. Q., Pittsburg, Pa.

Rubbing of the glass top of a voltmeter and other instruments in dry weather causes the electrification of the glass. By induction this may cause the electrification and attraction of the needle or pointer, this force being sometimes stronger than that which causes the original deflection and therefore producing more or less error in the reading. It is not wrong to clean the glass, in fact, it is absolutely essential to proper observation of the pointer. To overcome the difficulty caused by rubbing the glass it is necessary merely to breathe upon it when it has been cleaned; the moisture in the breath dissipates the electric charge and therefore prevents distortion of the reading.

UNDERGROUND LINES WITHOUT CONDUIT.—Is it possible to run electric light cables underground without placing them in special conduit?—S. W., Riverside, Ill.

It is feasible to do this, but not advisable except in a few special cases. The almost exclusive employment of conduit for underground lines is because it serves both to protect the cables from displacement and mechanical injury and to afford a ready means of drawing in cables as needed and of withdrawing sections of them for repairs without fresh excavation and repaving. In some suburban towns, where trees are very dense and alleys entirely absent, underground distribution has been insisted on. As the load was not very great, a relatively inexpensive type of construction was imperative. For this purpose lead-covered, steel-armored cable protected against rusting by several layers of jute has been placed directly in the ground without conduit or even concrete about it. Such a system was described in the WESTERN ELECTRICIAN, February 8, 1908. Such an underground line can be installed only in streets or parkways where there is not likely to be indiscriminate excavation. The decreased cost of installation due to elimination of conduit and facility in laying is largely offset by the added cost of the armored cable. In some instances ordinary lead-covered cable has been laid directly in a narrow trench with only a little sand and a creosoted plank for protection on top, upon which the earth and sod are replaced. Against such cheap and insecure construction must be considered the low cost of many types of conduit and the advantages mentioned above of placing the cable in ducts.

LOW VOLTAGE FOR ISOLATED PLANTS.—In your issue of June 3, I notice a question regarding low-voltage plants, which is answered from the standpoint of city central-station plants. Is it not true, however, that low voltage is used in a great many isolated plants, particularly in the country?—G. S. G., Dayton. Ohio.

Further correspondence with the original inquirer has demonstrated that the question referred to town plants and not isolated ones. Therefore the published answer was entirely appropriate, because a town lighting plant should be laid out with the idea of growth into a central station of some magnitude. On the other hand, it is quite true that for isolated plants remote from any possible central-station lines, such as in many farm houses and country homes, low voltage is entirely suitable and, in fact, possesses some advantages. Such plants usually consist of a gasoline engine, a dynamo and a storage battery, the latter being charged by day. By the adoption of a low voltage, say, thirty-two volts, it is possible to use a battery of but sixteen cells as against fifty-five to sixty cells for 110 volts, thus giving a simpler and less expensive battery plant. At the same time very rugged standardized tungsten lamps of high efficiency become available. For these reasons low-voltage plants have become quite popular for remote isolated plants in all parts of the country.

HIGH-VOLTAGE TRANSMISSION.—What is the highest voltage used in power transmission?—D. S., Austin, Texas.

At the present time 110,000 volts is the highest potential maintained in regular service on transmission lines. Several such transmission systems are in successful operation in this country and one in Canada. One is projected in Germany. Occasionally the line voltage has been run up to 120,000 volts, but this has not been maintained steadily. A transmission system is now being constructed in Michigan which will be operated at 135,000 volts.

CONCRETE TIES.—Is it true that some California street railway is using concrete ties?—J. M., Denver, Colo.

The Los Angeles Railway Company, of Los Angeles, Cal., has definitely adopted the reinforced-concrete tie for all downtown lines. A limited number of ties of this description were laid on Spring Street two years ago as an experiment, and their use has proven so satisfactory that the company decided to adopt them as a permanent feature of construction on lines over which there is the heaviest traffic.

Announcement.

Beginning with the next volume of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, the first issue of which will appear on July 1, a change will be made in the manner of conducting the department of QUESTIONS AND ANSWERS. Heretofore questions have been answered directly by the editors, with the help of such literature as is available on the subject involved. Hereafter questions will be published as received, and answers will be invited from our readers, and published in a subsequent issue. It is believed that this will add to the interest of the department to our readers, and will also afford opportunity for the presentation of different points of view of the same subject. The editors invite the fullest discussion of the matters thus brought to attention.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.

The Westinghouse Electric & Manufacturing Company's annual report for the year ended March 31, 1911, shows gross earnings of $38,119,312, exceeding those of the preceding year by $8,870,630, and greater by $5,093,072 than the earnings of the best previous year. Net manufacturing profits of $5,608,765 were also record breaking. Total income for the period was $7,124,296, and the net income, or surplus, for the year was $4,881,105, as compared with $3,060,664 in the preceding year and a deficit of $1,405,015 in 1909.

The value of unfilled orders as of March 31 was, however, only $7,616,058, as against $11,256,196 on the same date a year back.

On March 31, 1896, the company entered into an agreement with the General Electric Company whereby for a period of fifteen years thereafter each company licensed the other under the patents controlled by it during the term of the agreement, with provision for the payment of royalties by each on the basis of its use of the patents of the other. For the past few years under the operation of this agreement the company has received substantial sums by way of royalties. This agreement expired by limitation of time on April 30, 1911. No renewal of it is contemplated. This source of revenue, therefore, cannot now be counted upon.

Other patent license agreements with manufacturers of mining locomotives, small motors, fuses, switches and sockets, under which the company has been working for some years, have recently been cancelled on the suggestion that they might be questioned as being in violation of the Federal anti-trust laws, notwithstanding they were originally made and have been maintained under advice of counsel that assured the company of their validity.

Large expenditures have been authorized for the purpose of strengthening the sales force and considerable amounts have been appropriated to the work of new development and for improvement in current types of apparatus.

This work has been particularly marked with respect to the redesigning of direct-current motors, alternating-current and direct-current mill and crane motors, small power motors, high-speed turbo-generators, circuit-breakers, railway equipment and heating and cooking apparatus. This is an item of expenditure which, owing to the position of the company, it is felt it would be unwise at any time to curtail. It must be borne in mind that the company must keep pace in technical skill and inventive ingenuity with its competitors even though their combined capital and manufacturing facilities are greater.

The company was made party defendant, during the year, together with the General Electric Company, the National Lamp Company and a number of other lamp manufacturers to a bill of equity recently filed by the United States under the provisions of the Sherman anti-trust law. The bill proceeds on the theory that certain agreements and acts of the lamp manufacturers, defendants in the suit, constitute a combination in restraint of trade. While it would not be proper to discuss in this report the matters involved in this proceeding, the directors feel justified in saying that the company's operations have been such that the outcome of the suit is not likely seriously to affect the conduct of its lamp business.

The consolidated balance sheet as of March 31, 1911, follows:

ASSETS.

Property and plant	$17,692,145.61
Sinking fund	445.48
Investments	24,034,635.99
Current assets	19,158,168.98
Working and trading assets	14,321,474.01
Other assets	7,188,640.29
Total assets	$82,395,510.36

LIABILITIES.

Capital stock	$40,693,287.50
Funded debt	22,607,000.00
Collateral notes	6,720,000.00
Long term notes	1,383,650.00
Real estate mortgages assumed in purchase of property	228,200.0
Current liabilities	3,168,373.70
Reserve	1,630,774.26
Surplus	5,964,224.90
Total liabilities	$82,395,510.36

The operations of the British company have been "quite uniformly unprofitable." The French company has been "steadily unprofitable," but the Italian company has succeeded in making some money for its parent corporation. On the contract for the electrification of the St. Petersburg tramways, the company lost over a million, and had much trouble with the authorities, who seized its private papers and otherwise molested the local officers. Up to date Russian propositions have cost the Westinghouse people more than $1,800,000. Disputes over fines imposed by St. Petersburg on the company are still being waged in the Russian courts. In Austria the company has been "measurably" successful in its operations. The Canadian organization has also done well.

It is believed that the book value of the London Lamp Company also will be realized.

The total book value of power-company securities carried is $211,498.24. The total book value of all investments is given as $24,034,635.99.

Chairman Robert Mather concludes his report by stating: "After a careful consideration of all of the circumstances, having due regard for the true condition of your balance sheet, hereinbefore minutely described to you, the elements of uncertainty as to the immediate future of your company's business, the need for cash for new foundry facilities, for extension of the Newark plant and other factory improvements, and the necessity of making wise provision for shortly maturing obligations, your directors have felt that it is not wise at the present time to weaken your company position by diverting its surplus earnings, even in part, to the payment of dividends on the assenting stock. Whenever a change in conditions shall lead your directors to feel that a different attitude can safely be assumed, the question will be reconsidered and determined in the light of such change; meanwhile your directors trust that, with the aid of the very intimate information which this report gives as to the situation and affairs of their company, the stockholders in general will be led to the same conclusion."

PORTLAND RAILWAY, LIGHT & POWER COMPANY.

The Portland Railway, Light & Power Company reports to the New York Stock Exchange for the year ended December 31, 1910, compared as follows:

	1910.	1909.
Gross earnings	$6,064,795	$5,190,567
Operating expenses	2,870,077	2,569,041
Net earnings	3,194,717	2,621,526
Fixed charges	1,678,228	1,493,039
Surplus	1,516,489	1,128,487
Preferred dividends	250,000	250,000
Surplus	1,266,489	878,487
Common dividends	400,000	200,000
Extraordinary repairs and rent	274,608	267,147
Surplus	591,881	411,339

Earnings for the four months ended April 30, 1911, follow:

Gross earnings	$2,032,109
Operating expenses	885,169
Net	1,146,940
Fixed charges	604,347
Surplus	542,593

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways of St. Louis for the month of April and four months ended April 30 compares as follows:

	1911	1910
April gross	$ 973,939	$ 938,648
Expenses and taxes	668,876	675,659
April net	305,063	262,989
Other income	3,400	2,943
Total income	308,463	265,932
Charges	229,436	233,539
April surplus	79,027	32,393
Four months gross	3,741,119	3,597,417
Expenses	2,603,185	2,573,650
Four months net	1,137,934	1,023,767
Other income	14,290	13,569
Total income	1,152,224	1,037,336
Charges	921,230	933,985
Four months surplus	230,994	103,351

MEXICAN TELEPHONE & TELEGRAPH.

The Mexican Telephone & Telegraph Company reports for the year ended February 28, 1911, compared as follows (Mexican currency):

	1911	1910
Gross	$564,419	$480,609
Operating expenses	258,274	229,592
Net	306,145	251,017
Subscribers	10,277	8,861

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.

The report of the Cumberland Telephone & Telegraph Company for the month of April and four months ended April 30, compares as follows:

	1911	1910
April gross	$ 604,632	$ 656,054
Expenses	366,895	321,239
April net	237,736	243,815
Charges, taxes, etc.	51,846	48,731
April surplus	185,890	195,084
Four months gross	2,383,309	2,230,652
Expenses	1,403,810	1,274,096
Four months net	979,498	956,556
Charges, taxes, etc.	206,682	191,594
Four months surplus	772,816	764,961

INTERBOROUGH RAPID TRANSIT.

The earnings of the Interborough Rapid Transit Company for the month of April and ten months ended April 30, 1911, compare as follows:

	1911	1910
Gross operating revenue	$ 2,658,586	$ 2,564,775
Operating expenses	1,071,177	937,047
Net operating revenue	1,583,408	1,627,727
Taxes	167,047	156,643
Income from operation	1,420,362	1,471,084
Other income	26,047	29,670
Total income	1,446,408	1,500,755
Interest, rentals, etc, including Manhattan guarantee	888,030	878,356
Net corporate income	558,377	622,399
Passengers carried	51,774,277	49,878,523
July 1 to April 30:		
Gross operating revenue	$24,781,481	$24,094,853
Operating expenses	10,237,995	9,148,534
Net operating revenue	14,543,486	14,946,319
Taxes	1,560,253	1,429,488
Income from operation	12,983,233	13,516,813
Other income	277,707	349,726
Total income	13,260,939	13,866,557
Interest, rentals, etc., including Manhattan guarantee	8,874,328	8,791,071
Net corporate income	4,386,611	5,075,486
Dividends (nine months).	2,362,500	2,362,500
Surplus	2,024,111	2,712,986
Passengers carried	481,191,629	467,848,217

The increase in operating expenses is largely due to extraordinary expenditures, the result of changes in subway equipment made necessary in connection with the operation of ten-car express and six-car local trains.

AURORA, ELGIN & CHICAGO.

The report of the Aurora, Elgin & Chicago Railroad Company for the month of April and ten months ended April 30, 1911, compares as follows:

	1911.	1910.
April gross	$ 130,913	$ 120,384
Expenses	78,036	71,150
April net	52,877	49,234
Charges and taxes	35,571	33,310
April surplus	17,306	15,924
Ten months' gross	1,421,542	1,302,282
Expenses	822,187	726,760
Ten months' net	599,355	575,522
Charges and taxes	344,264	307,266
Ten months' surplus	25,091	268,257

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company, for the month of April and seven months ended April 30, 1911, compares as follows:

	1911	1910
April gross	$ 372,309	$ 344,765
Expenses	200,719	190,842
April net	171,590	153,923
Charges and taxes	50,338	44,584
April surplus	121,252	109,339
Seven months' gross	2,575,224	2,237,001
Expenses	1,571,191	1,407,826
Seven months' net	1,004,032	929,175
Charges and taxes	279,543	257,170
Seven months' surplus	724,489	672,005

ELECTRICAL PROPERTIES COMPANY.

The Electrical Properties Company has issued its report for the year ended April 30, 1911. The income account compares as follows:

	1911	1910
Income from interest and dividends on securities owned and interest on notes	$ 251,841	$ 239,053
Expenses, taxes, etc.	62,101	54,062
Net income	189,740	184,991
Preferred dividends	.....	181,775
Surplus	189,740	3,215
Profit and loss red. in val. sec.	51,103	.....
Previous surplus	92,981	89,765
Profit and loss surplus	231,618	92,981

Southern Railway Merger.

Consolidation of the New Orleans Railway & Light Company with a number of similar enterprises in other southern cities owned by the American Cities Railway & Light Company has been planned through the organization of a $38,000,000 company, which is to acquire at least two-thirds of the preferred and common stocks of the New Orleans Railway & Light Company, and the stocks of these properties of the American Cities Railway & Light Company, Birmingham Railway, Light & Power Company, Memphis Street Railway Company, Little Rock Railway & Electric Company, Knoxville Electric Company, and Houston Lighting & Power Co.

The preferred stock over the $15,333,333 issued for the acquisition of the New Orleans Company and the common stock over the $6,666,666 required for the same purpose will be used to acquire the subsidiaries of the American Cities Railway & Light Company, together with approximately $1,500,000 to be used by the new company for working capital.

AMONG THE CONTRACTORS AND SUPPLY MEN

HORTON D. WALKER, Brattleboro, Vt., received the contract for wiring the Brattleboro Congregational Church.

FOGG & RYAN, electrical contractors, of Sioux City, Iowa, have closed out, Fogg selling to E. L. Snyder. The company will be re-incorporated as the Electrical Engineering Company.

THE BENTON ELECTRIC COMPANY, La Crosse, Wis., was awarded the contract for installing wiring and conduits in the old post office in that city. The contract price was $1,495.

VAN NORT BROTHERS ELECTRIC COMPANY, Jefferson City, Mo., was given the contract for installing conduits, wiring, etc., in the United States public building in Jefferson City. The price bid was $2,625.

THE HIBBARD ELECTRICAL COMPANY, Fitchburg, Mass., has opened a new store, and will keep a complete line of electrical supplies and material. The company will also do general electrical contracting work.

THE CITY ELECTRIC COMPANY, of Tuscaloosa, Ala., secured the contract for installing an electric lighting system in the town of Reform. The contract requires that the lamps shall be installed and wiring completed by July 1.

THE SPRINGFIELD ELECTRIC COMPANY, Jacksonville, Fla., has opened an electrical supply store in that city. D. P. Moseley, who is at the head of the company, has been in the electrical contracting business for a number of years.

THE ACORN ELECTRIC COMPANY, Chicago, Ill., has commenced business with a capital of $2,500, and will do a general electrical contracting and construction business. The incorporators of the company are Arthur M. LeWald, Preston Davies, and Harold P. LeWald.

M. R. McCREHEN, of Columbus, O., who for the past three years has been in charge of the supply department of the McKeever Electrical Supply Company of that city, has opened a new store at 393 North High Street, known as the Ohio Electrical Supply Company. Mr. McCrehen will handle and keep in stock everything electrical.

New Electrical and Mechanical Apparatus and Appliances.

Luminous-Arc Headlights for Electric Cars.

Speed and safety are factors of prime importance in the satisfactory operation of modern electric-railway service, and call for the utmost vigilance on the part of the motorman. This is especially true at night when darkness materially increases the hazards by curtailing the vision of the motorman, and of other travelers and pedestrians. Under these conditions the use of efficient headlights gives the greatest aid to the motorman and affords the surest protection to the general public.

The new luminous-arc headlights developed by the General Electric Company are carefully designed to satisfy all the possible requirements of electric-railway service. There are eight styles, including suitable headlights for high-speed suburban and interurban cars, and for mine service. All styles operate on the same principle and differ only in the details of mechanical construction and equipment required for adapting them to the various classes of service.

The lamp mechanism is of the non-regulating type, being arranged for

LUMINOUS-ARC HEADLIGHT WITH ARC LAMP.

maintaining an arc of fixed length at the focus of the reflector. This is accomplished by the use of the slow-burning electrodes which are advantageously used for the production of the luminous magnetite arc. The positive electrode, consisting of a copper forging sheathed in non-oxidizable metal, has a life of 2,000 to 3,000 hours, and the negative electrode, which is a welded-steel tube filled with the mixture of oxide of iron and other ingredients for forming the luminous arc, has a life of 60 to 80 hours. The positive electrode is held stationary, and since it may be considered as practi-

LUMINOUS-ARC HEADLIGHT WITH INCANDESCENT LAMP.

cally non-consuming, always keeps the arc at the focus of the reflector, while the slow rate of consumption of the negative electrode maintains the length of the arc within safe voltage limits. The practical value of this feature lies in the convenience and in the low maintenance cost insured. The motorman is not compelled to make any electrode adjustments whatever, and the long life of the electrodes require renewals only at infrequent intervals.

Another characteristic of the magnetite arc, advantageously utilized in these headlights, is its reduced luminosity when the polarity is reversed. The glare of headlights of sufficient power to satisfy the requirements of high-speed suburban and interurban service render them prohibitory within the limits of some cities, towns and other populous districts, unless they are sufficiently dimmed during in-town operation. Usually, the glare is modified by the use of mechanical screens, operated by crude and inconvenient methods. All these drawbacks are eliminated, however, by the use of the magnetite arc. By simply throwing a switch and thus reversing the polarity the motorman obtains either full or dimmed illumination at will.

In-town dimming can be satisfactorily accomplished also by means of auxiliary incandescent lamps, therefore several of the styles available are equipped with standard sixteen-candle-power 110-volt incandescent lamps and suitable resistances for operating them across the nominal railway circuit potential.

The headlights designed for suburban cars operating on tracks having numerous curves and intersecting roads are equipped with parabolic reflectors of highly polished metal, which furnish a broad fan of light, extending directly from the head of the car to a distance of fifty feet on each side and to 1,200 or 1,500 feet up the track. This character of illumination is peculiarly suitable for suburban service as it enables the motorman to see around curves, to some extent, and also to detect the presence of persons or vehicles approaching at right angles to the track. These headlights are fitted with special chimneys or shields for cutting off the undesirable side rays, and are arranged for in-town dimming by reversed polarity, or by means of auxiliary incandescent lamps.

The headlights designed for high-

HEADLIGHT EQUIPPED WITH SEMAPHORE LENS.

speed suburban and interurban cars are equipped with mirrors or with semaphore lenses and spherical reflectors. They furnish a powerful beam of light which penetrates the darkness to a distance of about 2,000 feet ahead of the car. Since it is estimated that an interurban limited, traveling at sixty miles an hour, can be brought to a stop, with good braking, within a distance of 1,750 feet, these headlights provide an

ample factor of safety. Styles arranged for dimming, either by reversed polarity or by means of auxiliary incandescent lamps, are available, as may be desired.

This entire line of headlights represents the latest product in this class of apparatus. Of simple design, rugged construction, and minimum weight, they constitute units of high efficiency, which can be operated with a minimum amount of trouble and a low cost of maintenance.

Unless otherwise ordered, all styles are designed to operate on a nominal potential of 550 volts with eighty volts at the arc and a current of four amperes. The difference between the line and arc potentials can be controlled either by suitable resistance or by incandescent lamps. In the latter case the incandescent lamps can readily be used to light the interior of the car, and simple wiring arrangements made to keep them lighted when the headlight is not in operation.

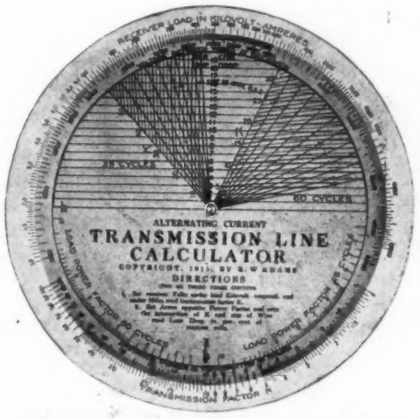
Transmission-Line Calculator.

For the benefit of operating engineers and superintendents who desire a rapid and accurate method of making determinations of the voltage and energy loss in alternating-current transmission lines and distributing circuits there has been devised and is now being placed on the market a simple and reliable device for calculating the line drop and energy loss in alternating-current circuits. This device is called the alternating-current transmission-line calculator, and is published and for sale by Robert W. Adams, No. 10 Hyde Street, Newton Highlands, Mass.

The calculator consists of two disks, a stationary one of opaque white celluloid 4.12 inches in diameter, and a revolving one of transparent celluloid 3.56 inches in diameter, eyeletted to the stationary disk so as to turn easily upon it. The disks are printed with the necessary diagrams, the stationary diagram being in red and the revolving diagram in black to permit of easy reading. The printing is done by a patented process which renders the lines moisture proof and non-erasible. The ranges of the various scales are as follows:

Load	10	to 20,000	kilovolt-amperes
Voltage	1,000	to 50,000	volts
Power factory	10	to 100	per cent
Distance	1	to 100	miles
Conductor	No. 8	to 0000	B. & S. copper
Line drop	0	to 20	per cent
Frequency	25	or 60	cycles

The operation of the calculator is extremely simple, as it is only necessary to make two settings to obtain the result. The value "K" which is obtained in the first setting is a transmission factor depending on the load, voltage and distance of transmission, and this factor is used directly in the second setting to determine the line drop or regulation, which is defined as the difference in voltage between the two ends of the line expressed in per cent of the receiver voltage. The method of securing the result includes in an accurate manner the effect of load power-factor, which has become increasingly important with the recent remarkable development of motor load, and, furthermore, is easily reversible, a feature which is not possessed by the algebraic methods, and one which is of great value where it is desired to obtain the size of wire necessary to produce a given drop.



TRANSMISSION LINE CALCULATOR.

Complete directions are printed on the back of the calculator together with a typical example, by following which a person having no technical training whatever can learn the method in a few minutes. There is no book of rules to get lost, and no auxiliary tables or data of any kind are required. This self-contained feature of the device adds greatly to the convenience of using it, and makes it especially useful in the field.

Upon the back of the stationary disk is also printed a convenient reference table giving the weights and costs of bare and triple-braided weather-proof copper wire per mile of two, three and four-wire circuit.

Another unique and useful feature is that the two lower revolving scales ordinarily representing distance and transmission factor, can also be used as an emergency slide rule for solving problems in multiplication and division.

A feature which will appeal to professional engineers is the rapidity with which trial and check calculations can be made with this device. The time required for a person acquainted with the calculator to make a complete determination of line drop is less than one minute, while the time required for an expert to apply one of the older methods ranges from five to twenty-five minutes, according to the method selected and the accuracy desired.

The calculator is based on the use of annealed copper wire at twenty degrees centigrade or hard-drawn copper wire at fifteen degrees centigrade, and on three-wire three-phase, and four-wire two-phase circuits. Single-phase circuits can be calculated as easily as three-phase, although the device is primarily designed for three-phase circuits as being the most common for transmission work. The accuracy of the calculator will compare favorably with similar results obtained by any of the formula or graphic methods, and in all cases will come far within that of the original assumptions of load and power-factor.

Electric Storage Battery Company to Erect Big Buildings.

The Electric Storage Battery Company of Philadelphia has closed a contract with John G. Brown, contractor and builder, Witherspoon Building, Philadelphia, for an addition to its present plant. The new building will be approximately 300 feet long by 115 feet wide, six stories high, with a one-story triangular extension about 80 by 120 feet. These buildings will be constructed according to the Brown patented system of mushroom reinforced-concrete construction, and are designed to meet the particular requirements of the company.

The demand for storage batteries of this company's manufacture has increased to such an extent that it has become necessary to provide additional manufacturing facilities at once. The enormous demand made upon the concern for its "Exide" and "Ironclad-Exide" electric-vehicle batteries has greatly increased its activities.

The new building will be of the most approved design, strictly fireproof, and will be provided with the most up-to-date machinery and the finest facilities for the convenience of its employees.

Gas-Electric Vehicle for Contractors.

A gas-electric motor truck is being manufactured by the Cleveland Motor Truck Manufacturing Company, Cleveland, O., specially suited for contractors and road builders, that embodies a number of interesting features.

The truck is so constructed that a center-dump bed of four-ton capacity can be used on the truck. The truck can be readily applied as a tractor in place of a traction engine, and will not be as destructive to the roads as a traction engine.

Where the truck is used for road train purposes, hauling seven five-ton center-dump wagons, the standard truck is used; only a larger engine and generator is used than in the standard four-ton truck. The engine and generator so placed on the truck is of sufficient size to furnish power not only for itself but to a pair of electric motor-driven wheels on each dump wagon in the train.

The great objection heretofore to a traction engine drawing a wagon train has been that the traction all coming on two of the wheels of the engine loosens the ground, even on the hardest macadam, while the gas-electric motor truck will drive on all four wheels, and, in addition, will supply the current for one pair of motor-driven wheels on each dump wagon in the train, thereby distributing the traction through the entire train and on twenty-four wheels instead of on the two wheels as in the traction engine, and at the same time giving a speed of from 6 to 10 miles per hour, as the road will permit.

The motor-driven wheels on the dump wagon are given as forty-two inches, the same height as the ordinary wheel (or other pair of wheels) on the dump wagon. This is done by placing a wooden felloe around the thirty-six-inch standard wheel and thereby giving either a wooden or steel tire sixteen inches wide for the dump-wagon wheel. The size of the wheel on the motor truck itself is given as thirty-six inches in diameter with a rubber tire, and in this case the truck can be used for purposes other than a wagon train; but they can place the wooden felloe on the motor truck itself, also with a wooden tire, but in that case the truck could not be used for any work other than pulling a wagon train, as it would not be advisable to get a speed higher than six or eight miles an hour with the wooden or steel tires.

Lehigh Valley Installs Telephone Dispatching.

To expedite the work of handling trains in and about its Jersey City yards, the Lehigh Valley Railroad has applied to terminal operation the methods already employed in dispatching scheduled trains. A telephone system under the supervision of the general yard-master with telephone lines extending to every coal pocket, freight house, yard office, switch and other point with which he is required to keep in touch, has been installed. Western Electric selectors and telephones, with which the rest of the Lehigh Valley's extensive dispatching system has been equipped, are used.

Special equipment was designed for this telephone system. Each office is supplied with a wall set or transmitter arm. At several points, the standard bell in the selector set is replaced with a loud-ringing gong, since there is no yard man in regular attendance. Each one of these station sets is provided with a push button, enabling the yard man to signal the dispatcher in case he is not on the circuit by ringing a bell in the yard-master's office. A test box, by means of which the yard-master can quickly locate trouble on the line, is also provided.

The yard-master is provided with a cabinet in which are mounted a master calling key and several switching keys. He uses a suspended-type transmitter in place of the ordinary dispatcher's-chest transmitter set.

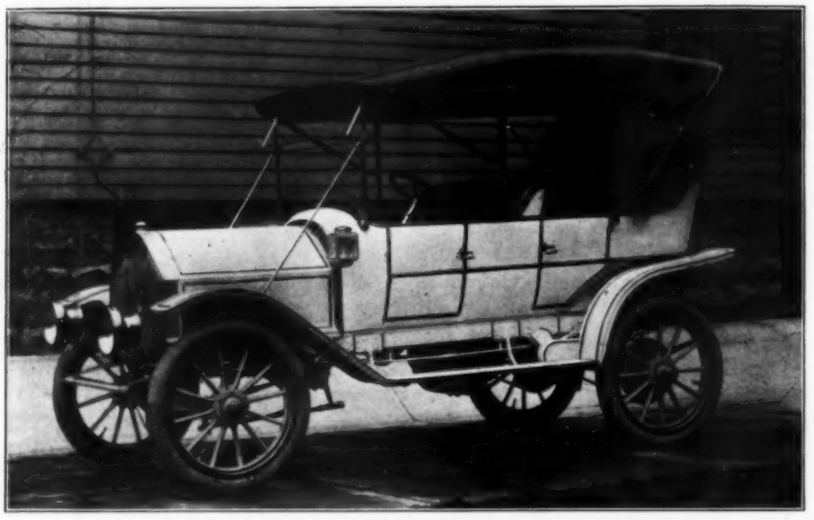
It is believed that the Lehigh Valley is the first railroad in the East to apply telephone train-dispatching methods to direct car movements in a local yard.

Babcock Electric Touring Car.

The Model 16 Babcock electric touring car, shown in the accompanying illustration, meets the requirements of those who desire a vehicle combining the simplicity of operation and low cost of upkeep of an electric with the lines of a gasoline car. As is obvious, this model conforms in general construction to the latest types of high-priced gasoline automobiles. It seats five persons comfortably, and the makers claim that no detail has been overlooked.

The equipment is of the standard type regularly used on Babcock electric vehicles, with the exception of the extra battery equipment—sixty cells of Edison 6-A battery being furnished.

The motor is of special design and will develop twenty horsepower. Five speeds forward and one reverse constitute the control. The wheel base is 105 inches and the transmission is by means of a double chain inclosed in a dust-proof case. The brakes, springs, tires, etc., are of the highest standard.



BABCOCK ELECTRIC TOURING CAR.

An interesting record of the performance of a Babcock vehicle of this type was contained in a telegram received at the home office from Chicago stating that Irwin Kuhn, of Chicago, drove a five-passenger Babcock touring car 100 miles in four hours and forty-eight minutes, and 112 miles in five hours and 28 minutes, over the boulevards of Chicago, making an average speed of about twenty-one miles an hour.

Mr. Babcock states that this is the fastest 100 miles ever made in an electric car of any description in America.

The Babcock Electric Carriage Company, of Buffalo, N. Y., is the maker.

Allis-Chalmers Lighting Transformers.

The general design of lighting transformers has been well established for many years, but occasionally marked improvements in details have been made which have greatly increased the practical value of this type of electrical apparatus. The new line of lighting transformers which Allis-Chalmers Company is now placing on the market brings out this point very fully, as radical departures have been made from older designs. These changes have produced a transformer in which the heat is conducted to the air from the coils in a much more rapid manner than is usually the case, thus insuring a transformer with an exceedingly low temperature rise.

The greatest visible change in these transformers is a provision, in the larger sizes, of three cooling surfaces instead of the single surface in the ordinary plain-case transformer. This is accomplished by encircling the main case with a jacket and providing for the circulation of oil between the two.

ALLIS-CHALMERS LIGHTING TRANSFORMER.

Both the tank and the jacket are made of boiler plate. They are connected at top and bottom by short tubes leaving an air space between the two. All joints are welded, making both the tank jacket seamless, and absolutely preventing the chance of leakage. In addition to the three radiating surfaces provided, the space between the jacket and the tank forms a flue which causes currents of air to ascend at a considerable velocity, thereby exerting a scrubbing action on the surface which greatly facilitates heat dissipation. This style of tank is used on all lighting transformers from 20 to 50

K.-W. SWITCH ATTACHED TO FIXTURE.

kilovolt-amperes, inclusive. The tubes connecting the top and bottom of the tank and jacket provide for a continuous and positive circulation of the oil. Tests made on these show that this circulation is rapid and that heat is quickly conducted from the transformer through the oil to the surface of the tank and jacket and thence to the air.

An entirely new departure has also been made in the 40 and 50 kilovolt-ampere sizes by so arranging the coils that there is a ventilating space between them which allows full and free circulation of the oil. These sizes are wound with two low-voltage and one high-voltage coil, the latter being placed between the other two. The coils are separated from each other and the space between them provides ventilating ducts on each side of the high-voltage coil through which the oil can readily circulate. This ventilating feature helps to make a transformer that is extremely cool in operation.

All these transformers are supplied with the five per cent and ten per cent taps which have long distinguished Allis-Chalmers transformers. These taps or leads are connected near each end of the primary winding and enable normal secondary voltage to be secured, even if the voltage supplied the primary coil is five per cent or ten per cent below normal. These transformers are designed for use on 2,200-volt or 1,100-volt lines. The use of the taps makes it possible to step down from 2,200 volts in nine different ratios and from 1,100 volts in six different ratios.

Allis-Chalmers Company claims that these many special and useful features give a transformer having extremely satisfactory operating characteristics and one which is unexcelled for central-station work.

The K-W Switch.

A new switch which can be applied to electroliers, clusters, combination fixtures or straight electric fixtures, for controlling the lamps individually is being placed on the market by the Wi-Ko Electric Company, 1830 Ellen Street, Chicago, Ill. One of the accompanying illustrations shows the switch applied to a tungsten cluster, the base of the fixture being removed to show the connection. The other illustration shows the switch applied to the cross arm of an ordinary two-light fixture.

With this switch, which is known as the type W-K, each lamp of a fixture or cluster can be lighted individually by a pull on the pendant chain. Also each is turned off successively. This permits of regulating the amount of light without the necessity of unscrewing the

K.-W. SWITCH ON CROSS ARM.

lamps not to be used, which operation is particularly inconvenient when the lamps are hung some distance from the floor.

The new switch can be applied to practically every type of fixture and does not, in any way, change its appearance, being hidden in the bottom shell of the fixture. It can be very easily installed without taking down the old fixture.

Measurement of Current without Interrupting the Circuit.

An apparatus has been placed on the market by R. W. Paul, of South Newgate, England, for measuring the current flowing in a conductor where it is impossible to break the circuit for the purpose of inserting an ammeter. The apparatus comprises a contact block with potential points and leads for connection to a millivoltmeter. The contact block is strapped by leather bands to the bare conductor. The millivoltmeter is so graduated that its reading multiplied by the cross section of the conductor in square inches gives the value of the current in amperes. The millivoltmeter reading really gives the current density in the conductor. The product of this reading and the area of cross-section gives the total current. This applies to copper conductors. In the case of other metals the readings must be multiplied by the proportional conductivity. A simple circular slide rule is also provided. This is graduated in square inches and in sizes of stranded cable, and enables the value of the current to be read off very quickly.

This apparatus is not intended for use as a precision instrument, but readings can be made within a few per cent. In addition to its use for measuring current the apparatus provides a simple means for testing the conductivities of contacts, joints, fuses, etc.

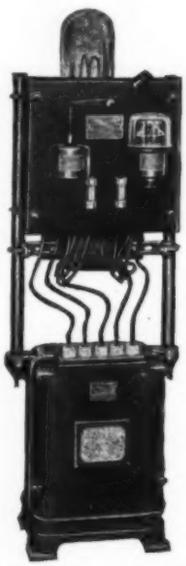
New Gasoline-Electric Bus for London.

Novelty in the shape of a new type of motor bus is, according to the *American Machinist*, said to be under contemplation for the streets of London. These vehicles are of the combined gasoline-electric variety, but are entirely new in many respects. Two independent twelve-horsepower four-cylinder gasoline motors each drive, through an electric "dynamotor" and a flexible shaft, one of the rear wheels of the vehicle. When the load is light, the excess power of the engines is absorbed by the dynamotors as dynamos to charge a special storage battery. When the load is heavy, the dynamotors automatically are changed into electric motors and assist the engines, taking power from the batteries. By this arrangement not only are starting and control much smoother and quieter, but by the more constant load upon the engines, the fuel economy is much improved.

Making Photo Plays Successful.

One of the most important factors contributing to the success of a motion-picture theater is the quality and brilliancy of the light projected from the lamps. For pleasing effect motion pictures require a steady white light of sufficient intensity to bring out the natural light and color values of the films, and the theater having the better quality of light stands the best show of getting the biggest patronage.

Motion-picture operators are well aware of this, and also of the fact that the light obtained from direct current is much superior to that of alternating-



MERCURY-ARC RECTIFIER.

current arcs. However, until recently, all those who could obtain only alternating-current supply have gotten along with the poorer quality of light, simply for the lack of apparatus for economically converting alternating current into direct current.

However, it is a universal law, "that where there is a demand an adequate supply is bound to come," and the application of this law in the case of the motion-picture world is interestingly shown in the development of the mercury-arc rectifier by the General Electric Company. In other words, an electrical manufacturer of the first magnitude has recognized the pressing need of direct current by the motion-picture operators, and has produced an apparatus which not only furnishes current of the desired character, but also supplies it at a cost less than that of the most economically operated alternating-current arc.

The significance of this development to the ten thousand or more motion-picture theaters now using alternating current can be demonstrated in several ways, but most instructively, perhaps, by a comparison of the cost of producing a given intensity of projected light from alternating, direct, and rectified current, with the most approved economizing devices applicable in each case.

There are certain facts, however, which should be borne in mind while making such an analysis, since they are too well founded to require any demonstration. For instance: the best class of motion pictures require a light intensity upwards of 8,000 candlepower, and as 5,000 candlepower is the maximum obtainable from alternating current with the best economizers or the highest current values practicable, it is evident that the use of alternating current under such conditions is entirely unsatisfactory owing to the insufficiency of the light. Furthermore, when to insufficiency is added an objectionable flickering, together with an uncertain intensity of the projected rays, due to the wandering of the arc around the tips of the carbons, thereby often causing the forming of the hottest or most brilliant spot at the back of the electrodes, it is not surprising that motion-picture operators have been vigorously demanding something more satisfactory than the alternating-current arc.

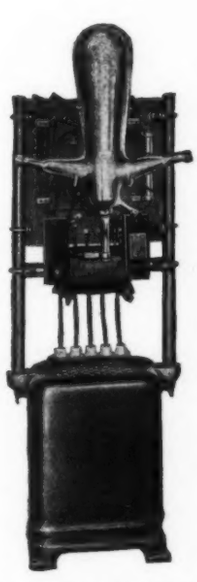
Of course, where direct-current supply was obtainable, some have found relief by using it, but their experience has served to emphasize the prohibitory value of the additional cost entailed by the loss of at least sixty per cent of the energy drawn from the line in the resistance or rheostat employed to regulate the current in the arc.

These facts serve to define the limitations of both the alternating and the direct-current arcs relative to motion-picture lighting, but in order to give the various alternating current with economizer methods a fair deal, assume that a light intensity of 5,000 candlepower is required. From actual determinations, carefully made, it is found that to obtain 5,000 candlepower from a 110-volt alternating-current circuit, with rheostat, requires seven kilowatts; a 110-volt direct-current circuit, with rheostat, requires 2.25 kilowatts; any alternating-current circuit,

with economizer, requires 2.1 kilowatts; any alternating-current circuit, with mercury-arc rectifier, requires 1.7 kilowatts. Since economy arc transformers are extensively used on alternating-current supply with a substantial reduction in energy consumption, the method of using alternating current with rheostats may be considered as obsolete, and since a prohibitory amount of energy is wasted in using direct current with a rheostat, that method, also, can be omitted from present consideration. This enables a direct comparison between the results obtained from alternating current with the use of economizers on the one hand and mercury-arc rectifiers on the other.

The figures show a difference of 400 watts per hour in favor of the mercury-arc rectifier. This means, that on the basis of an average daily run of seven hours at a cost of six cents a kilowatt, the use of a mercury-arc rectifier provides a light having all the advantages of that given by a direct-current arc, at a cost of at least $60 per year less than that obtained from alternating current with economizer.

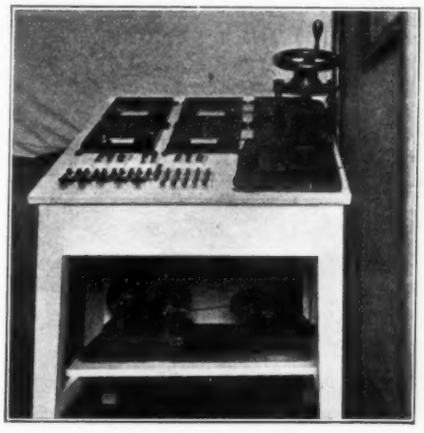
Furthermore, it is evident that when the light intensity required exceeds 5,000 candlepower, thus rendering the alternating current with economizer method inapplicable, the saving effected by the use of the mercury-arc rectifier as compared to the cost of using direct current with a rheostat is much more significant.



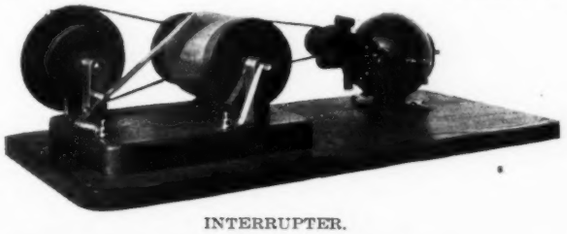
REAR OF RECTIFIER.

Exhibit of Alternating-Current Switchboard Instruments.

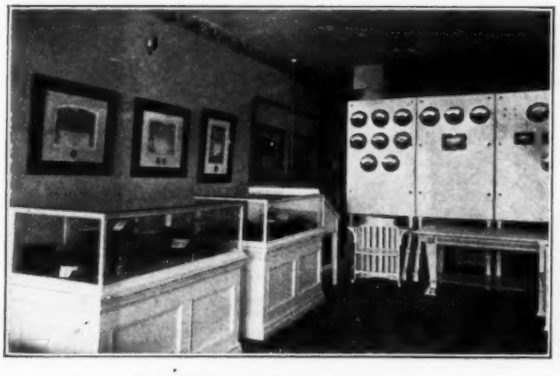
During the recent National Electric Light Association convention at New York City, the Weston Electrical Instrument Company, of Newark, N. J., held an exhibition of switchboard instruments in a building across the street from the Engineering Societies' Building. The exhibit consisted of a complete equipment in operation and of instruments dismantled and placed in glass cases for inspection. The general view of the board and cases is shown in one of the illustrations.



BENCH BOARD FOR CONTROL.



INTERRUPTER.



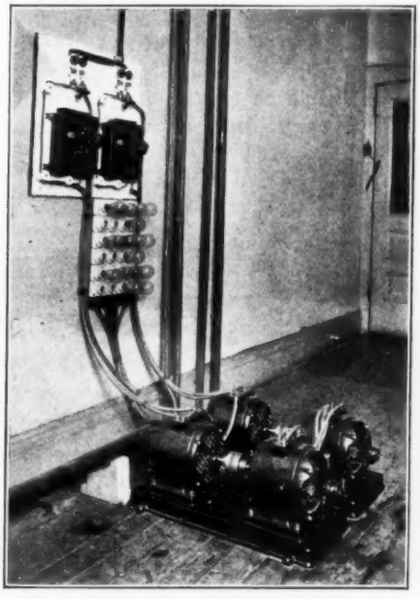
GENERAL VIEW OF EXHIBIT.

The operative installation was equipped with special devices for reproducing the severest operating conditions. The instruments were mounted on panels and all switches and controlling devices were installed on a bench board at one side and in front of the instrument board.

The operative instruments included the following: First panel at the left, beginning at the left top, Weston alternating-current voltmeter, ammeter, single-phase wattmeter, power-factor meter, frequency meter, synchroscope, direct-current voltmeter and ammeter; panel 2, Weston semi-flush polyphase wattmeter, full-front polyphase wattmeter, Y-connected wattmeter for balanced three-phase, Weston horizontal edgewise wattmeter; panel 3, Westinghouse synchroscope, Weston synchroscope, General Electric synchroscope, General Electric voltmeter and wattmeter, Westinghouse wattmeter and Weston wattmeter.

The power plant consisted of two 0.6-kilowatt Eck motor-generator sets. The load was made up of lamp banks and an adjustable reactor. As may be seen, two lamp banks are connected in series with an interrupter or flasher, and by operating this flasher the load could be made to fluctuate automatically.

The flasher shown in another illustration consists of a wooden drum partially enveloped with a triangular brass sheet connected to the axle, which in turn is joined to the circuit through a brush. The other terminal of the flasher is joined to a brush pivoted near one end and made to oscillate by a pin and cam acting against the pull of a string. The combined effect of the oscillation of the brush and the rotation of the cyl-



POWER PLANT.

inder is to give a non-periodic and irregular variation of the load.

In addition to the automatic contrivance for varying load, there are means for varying the power-factor from 0.50 to 1.00; of varying the frequency from 50 to 75 cycles per second, and of varying the electromotive force from 50 to 150 volts. Thus, it was possible to reproduce the severest conditions met with in commercial practice.

All the current coils of wattmeters, ammeter and power-factor meter were connected in series, and all potential coils were connected in multiple. Therefore, the readings were comparable with each other. That is, the wattmeter reading equalled the product of the readings of the power-factor meter, the voltmeter and the ammeter. The synchroscopes were connected in the usual way. All synchroscopes were connected in parallel.

In the show cases the parts and partially assembled movements were shown. These also included instruments of various makes so that, all in all, this was an exhibit of great scientific and practical educational value, in spite of the fact that it was operated under the auspices of a commercial interest.

A New Locking Feature for the Improved Buffalo Grip.

The Western Electric Company has recently placed on the market a new "Improved Buffalo Grip" with a special locking feature. In Fig. 1, the new grip is shown with the jaw held open

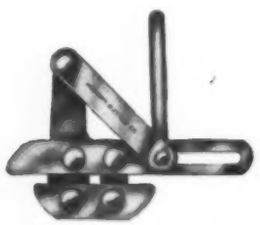


FIG. 1.—JAW HELD OPEN.

FIG. 2.—BUFFALO GRIP CLOSED.

by the locking device. A turn of the handle locks the jaw in any position and enables the lineman to easily and quickly insert the wire in the grip. When the handle is pushed down, as shown in Fig. 2, the wire is held in a tight grip.

The "Improved Buffalo Grip" is made in various sizes for both bare and insulated wire, and can be supplied both with and without pulleys.

Automatic Section Insulators.

Automatic section insulators are inserted at points where it is desirable to energize a section of trolley wire when the trolley passes onto it and to de-energize it when the trolley passes off. They are widely used in mining installations and are so constructed that a mining locomotive in entering a section will throw the switch of the insulator and energize the section. In returning, the trolley of the locomotive throws the switch in the opposite direction and renders dead the section controlled.

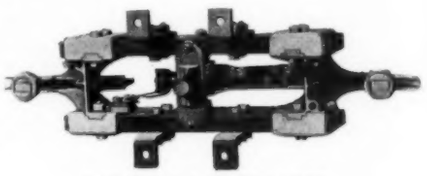
SIDE VIEW OF INSULATOR.

In construction the Westinghouse automatic section insulator is similar to the Westinghouse Type K.B. section insulator except that a circuit-opening-and-closing arrangement is incorporated in the automatic type. Side bars of impregnated hickory take the tensile stress due to the trolley wires. All metal parts are of either sherardized malleable iron or of a bronze composition. A wedge of the type that has given excellent service on standard trolley frogs is used to secure the trolley wire in each approach. Supplementing the wedge, an internally threaded chuck is provided. This, when tapped into its tapered hole, firmly grips the wire.

The chuck is the same as that used for the Westinghouse-Cleveland splice and for the K.B. section insulator.

Opening and closing of the circuit is effected by a switch blade, mounted on a rocker. In one position of the rocker the blade makes connection with spring contactors and in the other position contact is not made. The action of a spring prevents the rocker from remaining in an immediate position. All parts are of rugged construction and operate positively and satisfactorily.

Electricity is fed to the rocker switch blade through a heavy, flexible, woven-copper bond, which is securely connected at each of its ends. When the trolley wheel is inbound, no arc can be drawn across the knife switch and contact because their connection is completed before the trolley wheel leaves the rocker, which is always energized. In returning, the trolley does not open the branch line until the wheel has passed onto the rocker.



TOP VIEW OF INSULATOR.

As the automatic section insulator is used most frequently in mines, it is arranged for suspension from roof timbers. Four suspension angles are provided on the insulator, each of which is drilled for a lag screw. Any size of trolley wire can be used, but its size must be specified when ordering.

The 1912 Boston Electric Show.

As previously announced in these columns, the 1912 Boston Electric Show will be held in Boston, Mass., from September 28 to October 26, inclusive. The exhibits will occupy the whole of the Mechanics' Building, with over 100,000 square feet of exhibit floor space.

The organization of this show, the financial responsibility of its management, and the scope and policies of the undertaking are under the auspices and supervision of the Edison Electric Illuminating Company of Boston.

An attractive booklet containing space application blanks, diagrams of the exhibit space and the rules and regulations of the show, together with miscellaneous information of interest to prospective exhibitors is now ready for distribution. Herbert W. Moses, 39 Boylston Street, Boston, is manager.

Electrification in Switzerland.

Active measures are being taken by the Swiss railway authorities for the electrification of their lines. Several concessions for water power have been secured and work has been started. These concessions include water-power sites on both sides of the St. Gathard tunnel and one on the Rhone River in the canton Valais. The minimum output of the station to be erected at the latter point will be 15,500 horsepower.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, has ordered that the New York Telephone Company must reduce its rates from the Borough of Manhattan below One Hundred and Tenth Street to Brooklyn from ten to five cents a call; that the charge for a call from the same zone in Manhattan to Astoria and Newtown, L. I., must be cut from ten to five cents, and that from the same Manhattan territory to Flushing, Richmond Hill and Jamaica the rate for a call must be reduced from fifteen cents to ten cents. The change in rates is to be enforced on August 1.

The Appellate Division of the Supreme Court overruled the action of the Public Service Commission in refusing to approve the plan of reorganization of the Third Avenue Railroad Company. The Public Service Commission held that the reorganization was subject to its supervision because the Legislature had in its creation of a Public Service Commission repealed the portion of the Rapid Transit act dealing with the reorganization of such bankrupt roads and that all of the details of the reorganization of such roads were subject to the Public Service Commission's approval.

The Commission rejected a plan proposed by the Committee of Consolidated Bondholders under an agreement entered into September 6, 1908, in which it was proposed to issue $37,560,000 four per cent bonds and $15,995,800 of stock at par for contribution of new cash by old stockholders of $37,200,000. The Commission refused its approval on the ground that the actual value of the railroad properties did not warrant such a large issue of stocks and bonds.

The Public Service Commission, Second District, has received an application from the Orange County Traction Company asking for authority to issue $83,500 in five-per-cent fifty-year bonds secured by its first and refunding mortgage. It has asked that the bonds may be sold at not less than eighty-five, proceeds to be used for a new car barn, second track from West Street and Broadway, Newburgh, to Orange Lake, 5.12 miles, payment on Orange Lake property and a new 500-kilowatt rotary, fittings and switchboard.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Wisconsin Traction, Light, Heat & Power Company asked for a rehearing on the Commission's decision ordering a joint fare between that company and the Wisconsin Electric Railway Company in the city of Neenah. It was claimed by the applicant that since the distance traversed by its lines in the city is only 3,100 feet, it would be difficult for conductors to prevent passengers having a transfer from the connecting line from continuing their journey to Waverly Beach, the limit of the five-cent-fare zone, without paying an additional fare. The Commission stated that doubtless oversight on the part of the conductors would occasionally result in a passenger stealing a ride but such cases would be the exception and not the rule, otherwise it would be necessary to indict the traveling public with dishonesty. "To defraud a railroad is neither morally or legally less culpable than to defraud an individual." The Commission held that the instant case is not parallel to that of forming a business connection between an interurban and an urban system of railway. Here both companies are operating within a single municipality under street railway franchises, and are obliged to furnish service within the municipality. Public convenience requires that they be operated in conjunction with each other in rendering such service. If the compensation to each company for the portion of the joint service rendered by it is reasonably adequate, no just complaint can be made because of a requirement that an arrangement for a joint fare be entered into.

The Ripon Light & Water Company has submitted a schedule of power rates for its new day service for the approval of the Commission. The schedule is as follows:

First 100 kilowatt-hours per month	9.0 cents per kilowatt-hour
Next 100 kilowatt-hours per month	7.2 cents per kilowatt-hour
Next 100 kilowatt-hours per month	6.3 cents per kilowatt-hour
Next 300 kilowatt-hours per month	5.4 cents per kilowatt-hour
Next 400 kilowatt-hours per month	4.5 cents per kilowatt-hour
All over 1,000 kilowatt-hours per month	3.6 cents per kilowatt-hour

Minimum Rates: For motors of two horsepower or less, $2.00 per month. For each horsepower or fraction thereof over two horsepower, $1.00 per horsepower per month.

The Hayward Electric Light & Power Company submitted a revised schedule of rates for the Commission's approval but it was found that among the proposed changes were some which would affect increases to certain consumers and classes of consumers, and the company was notified that such changes could not be affected without a formal application and hearing before the Commission.

The Commission has made an inspection through its accounting staff of the books and accounting methods of the Elkhorn Municipal Water & Light Plant and has made an audit of the accounts of the plant. This is one of a number of such inspections which are being made for the purpose of increasing the efficiency of the accounting systems of the utilities and for the purpose of insuring the accuracy of the reports made to the Commission. Reports were recently required from all the companies operating in the state describing their accounting systems and their forms together with complete descriptions of the station records kept and the bases for the statistics reported to the Commission in the annual reports. The information gained through these reports and the personal inspection by members of the Commission's staff are being tabulated and the companies rated according to the condition of their accounting systems.

LIGHTING AND POWER.

(Special Correspondence.)

MINOT, N. D.—The Consumers' Power Company will rebuild its plant. C.

CUSTER, S. D.—The installation of an electric lighting system is being planned. C.

FORT PIERRE, S. D.—A. Winkler has made application for an electric light franchise.

COMANCHE, OKLA.—This city has voted a bond issue to establish an electric light plant.

ST. LOUIS, MO.—The Arcadia Country Club will construct a water-power electric light plant.

CHAMBERLAIN, S. D.—J. H. Kennedy and others are organizing a $50,000 electric light company.

NOKOMIS, ILL.—The Nokomis Electric Light & Power Company has asked for a twenty-year franchise. Z.

ALBION, ILL.—The Albion Electric Light Company is planning transmission lines to Bone Gap and Browns.

BRAHAM, MINN.—The Eastern Minnesota Power Company has been granted an electric light franchise here.

WAHPETON, N. D.—A new lighting system for Dakota Avenue is being considered by the Commercial Club. C.

WAUKEGAN, ILL.—Merchants of Genesee and Washington Streets contemplate an ornamental lighting system. Z.

FLORESVILLE, TEX.—A. B. Crawford, of San Antonio, Tex., contemplates installing an electric light plant here. P.

CANTON, ILL.—The Canton Commercial Club is planning an ornamental lighting system about the public square. Z.

TALIHINA, OKLA.—The Talihina Light & Power Company has been incorporated and will put in a $10,000 plant.

HAMPSHIRE, ILL.—Louis Koth is contemplating an electric light plant to light Hampshire, Burlington and Huntley. Z.

ANDERSON, MO.—The Anderson Water, Light, Heat & Power Company has been incorporated with a capital of $30,000.

SUSANVILLE, CAL.—The Town Trustees have granted the Lassen Electric Company an electric lighting franchise in this city. A.

WINONA, MINN.—A franchise was granted to the Minnesota-Wisconsin Power Company to supply the city with power, heat and light. C.

MOTLEY, MINN.—J. M. Quinn, of Brainerd, and others, are planning the construction of a power dam on the Crow Wing River. C.

RED LAKE FALLS, MINN.—The Red River Power Company is considering a proposition to supply farmers with electric light and power. C.

LIBBY, MONT.—The Libby Water Works, Electric Light & Power Company will begin the immediate construction of an electric light plant.

PAXTON, ILL.—The Paxton Electric Company is building a transmission line from Paxton to Loda where it has a contract to light the village. Z.

OLIVIA, MINN.—The Montevideo Company proposes to supply electric light to Olivia, Renville and Danube from its plant at Minnesota Falls. C.

TEMPLE, ARIZ.—An ornamental street lighting system has been installed by the South Side Gas & Electric Company. Tungsten lamps will be used.

BRAINERD, MINN.—The contract for furnishing the street-lighting system has been let to the Northwestern Electrical Equip-

ment Company at $3,080. The General Electric Company bid $3,273. C.

PRINCETON, MINN.—The Village Council granted a franchise to the Eastern Minnesota Power Company to install and maintain an electric light plant. C.

ALGONQUIN, ILL.—The North Shore Electric Company has purchased of D. W. Thomas and Antone Yeukel their water rights and electric light plant. Z.

LYNDON, KAN.—A proposition is being considered for supplying light and power to Melvern from the plant here. The local plant is municipally owned.

VANCOUVER, WASH.—The Washington Engineering & Securities Company has been incorporated with a capital of $3,500,000 to distribute light and power. C.

WASHINGTON, ILL.—LaFayette Birkett, C. H. Wagner and others of this city have asked for a franchise to construct and operate an electric light plant. Z.

ELGIN, ILL.—Extensive improvements are contemplated at the West Side electric light plant which recently was purchased at bankrupt sale by Walter Mills of Chicago. Z.

OAKLAND, ORE.—The City Council has decided to call an election to vote on the proposition of voting bonds to the amount of $15,000 to build an electric lighting plant. A.

MINONK, ILL.—The Minonk Electric Light & Power Company will amend its charter, it is reported, so as to operate transmission lines to Rutland, Toluca and probably Wenona. Z.

ALLEN, TEX.—The Allen Light & Power Company has been incorporated with a capital of $2,000. The incorporators are J. N. Bush, S. P. Bush, J. B. Preston and G. I. Wilcox.

SYCAMORE, ILL.—The Light Committee of the City Council is considering an ornamental lighting system. The members are E. E. Boynton, L. R. Sanford and William Murphy. Z.

GREENCASTLE, IND.—The City Council has voted to install an ornamental cluster-lighting system. The contract for the poles and light clusters will be let by contract to the lowest bidders. S.

PORT ANGELES, WASH.—The Olympic Power Company is developing a 25,000-horsepower hydroelectric plant on the Elwah River to be used in connection with a proposed railroad to run to Seattle. C.

CONCONULLY, WASH.—The City Council has taken favorable action on the proposition of establishing an electric lighting plant. A plant to cost between $5,000 and $10,000 is being considered. A.

BOISE, IDAHO.—The reclamation service has commenced the construction at Arrow Rock, twenty-two miles from here, of the highest dam in the world, estimated to cost $5,000,000 to $6,000,000. It will be constructed of concrete. C.

TERRELL, TEX.—The City Commission has let the contract for a reinforced concrete building to house its electric light and waterworks plant. The building is to be absolutely fireproof and will cost in the neighborhood of $6,000.

COCHITI, N. M.—The application of L. A. Hughes and G. W. Prichard for use of the water of the Rio Grande at this place for operating a large hydroelectric plant has been approved by the territorial engineer, Charles D. Miller. D.

FORT DODGE, IOWA.—The Northern Iowa Power Company let the contract for the construction of a concrete dam and auxiliary steam power. The plant will develop 2,750 horsepower and will be built at an estimated cost of $200,000. C.

SPRINGFIELD, MO.—Plans are being prepared for the remodeling of the plant of the Springfield Gas & Electric Company which was recently purchased by the Federal Light & Traction Company. The present capacity will probably be doubled.

MARQUETTE, MICH.—The contract for the construction of a dam on the Dead River was let to Powell & Mitchell at approximately $57,000, and for the Silver Lake dam to Wahlman & Trebilcock of Ishpeming, Mich., at approximately $15,000.

UXBRIDGE, R. I.—The Worcester Suburban Electric Company, with headquarters here, has decided to increase its power plant by a large addition and the installation of new and improved machinery. A new steam turbine of 2,000 horsepower will be installed and new condensers and other apparatus added.

EMPORIA, VA.—The development of the Roanoke River, from which 2,500 horsepower will be furnished to the proposed Gould electric railway from Norfolk to Baltimore, is soon to be started. The project arises from the merger of the Norfolk & Portsmouth Traction Company with the Virginian Railway & Power Company.

ELMORE, O.—The proposition to authorize a bond issue of $5,000 to install an electric lighting system was carried at a recent special election. The plan is to erect poles and wires and purchase the current, bids for which will be asked. The Lake Shore Electric and the Toledo, Port Huron and Lakeside lines are available. H.

CARLISLE, IND.—The Carlisle Gas & Electric Light Company has filed articles of incorporation. The company proposes to build, establish and equip a plant for the manufacture and distribution of gas and electricity for heat and light purposes in Carlisle. The directors are: Harry T. Alumbaugh, Wm. F. Dodge, John G. Frazer and Joseph Hume. S.

VANCOUVER, WASH.—Fire originating in the boiler room of the Vancouver plant of the Portland Railway, Light & Power Company of Portland, Ore., caused a loss placed at $63,000, on which there is an insurance of $35,000. The company is now bringing in current for light and power purposes over an emergency cable from its Portland plant. A.

OROVILLE, CAL.—Arrangements are being made by the Great Western Power Company to put a large force of men at work on the construction of a dam at Big Meadows, for which work the company now has $1,800,000 available. Options running till July 1 have been taken on all the lands in Big Meadows, except two ranches in the upper end. A.

DAYTON, O.—The Dayton Power & Light Company, which was recently incorporated, has increased its capital to $20,000,000. It has been reported that a merger of the street railway and lighting companies of the city is under way. This involves the street railways and the Citizens' Lighting Company and the Dayton Lighting Company.

PRINCE RUPERT, CAN.—C. H. Cahan and H. A. Lovett, who have figured prominently in many industrial organizations of late, are now forming a company to install a $5,000,000 hydroelectric plant, in which Montreal capitalists are expected to invest $2,000,000. It is expected that Prince Rupert will have 12,000 population in a short time and there is ample water power to fill all requirements in the neighborhood.

SPRINGFIELD, ORE.—The municipal power plant on the McKenzie River has been completed and power is now supplied to this city and other localities. The plant is located sixteen miles from Eugene and taking water through a ditch more than four miles long, generating 2,400 horsepower. Power is generated at 2,300 volts and transmitted at 22,000. The total cost of the plant, together with substations, etc., was nearly $200,000.

PITTSBURG, PA.—The Washington Electric Power Company, of Pennsylvania, a new corporation, will on July 1, take over the electric power plants for lighting and other purposes in Washington, Pa., Canonsburg, McDonald, Oakdale and Waynesburg. It will construct transmission lines from Washington to other points at once, so that a central power station may supply the towns mentioned and other near them. The amount involved in the organization is $1,200,000.

VERDI, NEV.—The Truckee River General Electric Company is rushing construction work on its new generating plant at this place. Water is to be taken from the Truckee River at Verdi and carried to a point two miles below town. The plant will consist of one generator that will develop about 3,200 horsepower, from which power will be supplied to consumers at Mason, Nev., and the surrounding country. It is expected that the plant will be ready to put in operation by September 1.

BRAZIL, IND.—The Terre Haute, Indianapolis & Eastern Traction Company is a competing bidder with the Brazil Electric Company for the city street-lighting contract. The traction company bids as follows: Arc light, all night schedule, five years, $67.00; ten years, $65.00 per lamp. Three-light tungsten cluster, $80.00 for five years; $77.50 for ten years. The Brazil Electric Company bids all night schedule, five years, $72.00; ten years, $64.00 per lamp; tungsten, three-light cluster, $124 for five years and $115 for ten years. S.

ELECTRIC RAILWAYS.

(Special Correspondence.)

WATERLOO, IOWA.—It is proposed to build an interurban to LaPorte. C.

BILLINGS, MONT.—A franchise has been granted to the Billings Traction Company.

MORGANTOWN, W. VA.—A trolley line between Morris and Maidsville is being considered.

BEMIDJI, MINN.—The installation of a complete system of electric street cars is being considered. C.

CHIPPEWA FALLS, WIS.—The street railway company may expend $2,000 improving its service. C.

RAYMOND, WASH.—Sanderson & Porter, New York, will build an electric railway to South Bend. C.

ST. CLOUD, MINN.—The Granite City Railway Company will extend its line to the Sauk River, prior to July 4. C.

ST. PAUL, MINN.—The street railway company will reconstruct its tracks on Fourth Street, this city, from Seven Corners to St. Peter. C.

CHISHOLM, MINN.—It is proposed to connect Hibbing, Gilbert, Buhl, Mountain Iron, Kinney, Virginia and Eveleth by electric railways. C.

FRESNO, CAL.—The Fresno, Hanford & Summit Lake Railway Company has completed sixteen miles of grading for its electric line. A.

LEAVENWORTH, WASH.—L. W. Pratt, J. B. Askew and W. M. Harvey have applied for a franchise for an electric street railway in this city. A.

WATERLOO, IOWA.—The Waterloo, Cedar Falls & Northern will build an electric interurban line to Laporte to be completed by January 1, 1912. C.

CHOTEAU, MONT.—The Choteau & Great Falls Railway Company, capital $100,000, has been incorporated by J. E. Malmin, Phil I. Cole of Choteau and others. C.

SACRAMENTO, CAL.—F. V. Keesling, president of the Sacramento-Folsom Electric Railway Company, has asked for a franchise for his proposed line in this city. A.

SISTERVILLE, W. VA.—Bonds to the amount of $200,000 were voted to assist in building an electric railway from Sisterville to Middlebourne. Work will be started soon.

WENATCHEE, WASH.—The Great Northern Railway Company has applied for franchises to construct electric lines to Pateros, Leavenworth and other cities in the valley. C.

MANKATO, MINN.—The North Mankato Commercial Club will try to secure the construction of the electric line by the Mankato Electric Traction Company to St. Peter through the village.

BERKELEY, CAL.—The Southern Pacific Railway Company has begun the laying of feed cables along its Berkeley suburban line, which will be the next one of the company's suburban lines to be electrified. A.

SAN LUIS OBISPO, CAL.—W. G. Lincoln, who has a petition for an electric railway franchise pending before the City Council, has now applied for a similar franchise covering the roads of the county outside of incorporated cities. A.

LOS ANGELES, CAL.—The Los Angeles & San Fernando Electric Railway Company has been incorporated here with a capital stock of $25,000 fully subscribed by L. C. Brand, E. T. Earl, W. G. Kerchoff, J. F. Sartori and Harry Chandler. A.

McKINNEY, TEX.—The Commercial Club of McKinney is promoting the construction of an interurban electric railway between this city and Bonham, about thirty-six miles. The route of the proposed line is through a populous agricultural section. D.

WATERLOO, IOWA.—The building of another branch of the Waterloo, Cedar Falls & Northern Railway, connecting Waterloo with LaPorte City, now seems assured, according to recent reports. The Commercial Club is strongly in favor of the new line.

HAGERSTOWN, MD.—It now seems certain that a Union power house will be built for the Frederick Railroad Company and the Hagerstown Electric Railway Company. The plant will probably be located at Security on the line of the Western Maryland Railroad.

LEWISTON, IDA.—The Boise-Council-Ladrone Railway Company, which has already completed preliminary surveys for its proposed road, has been incorporated with a capital stock of $2,000,000 by E. W. Rowman, C. M. Hail, D. S. Manville, Harry C. Wyman and George H. Bener. A.

BROWNSVILLE, TEX.—The City Council has ordered the Brownsville & Gulf Railway Company to remove its tracks which extend for a mile through the heart of the town, and is inviting applications for a franchise for an electric street railway system to cover the principal streets. D.

FLORENCE, CAL.—The Florence Interurban Electric Company, represented by B. F. Foor, has applied for a franchise to operate a car line between this city and the coal camp of Williamsburg, Rockvale and Coal Creek. It is estimated that the line can be constructed and equipped for $100,000.

FRESNO, CAL.—The San Joaquin Light & Power Company has appointed Frank W. Webster, who has supervised the rebuilding of electric railway systems at Fresno and Stockton, Cal., superintendent of construction at Bakersfield, Cal., where he will supervise the reconstruction of the company's system. A.

GREENVILLE, S. C.—The building of the line of the Interurban Electric Company, from this city to Greenwood by the Oliver Construction Company, is being rapidly pushed so that it may be possible to place rails within sixty days. The survey of the line to Spartanburg is also complete. By October 1 cars will probably be running into this city. L.

THEODORE, UTAH.—Plans and estimates are being made for the construction and equipment of a new eighty-five-mile trolley railway connecting Theodore, Colton, Myton and Roosevelt, Utah, and will be submitted shortly for approval and acceptance to the capitalists interested in the promotion and construction of the project.

TERRE HAUTE, IND.—Promoters of the Quincy & Terre Haute Electric Railroad announce that as soon as a new charter is procured at Quincy, Ill., contracts will be let for grading the line to connect Quincy, Liberty, Beverly, Kingston and Baylis and subsequently Terre Haute. W. C. Fick, of Quincy, Ill., is president. S.

OKLAHOMA CITY, OKLA.—The extension of the interurban line of the Oklahoma Railway Company, which was recently completed from Britton to Edmond, has now been opened to traffic. The line now runs from Oklahoma City to Edmond, a distance of fifteen miles. The intention of the company is to extend the line to Guthrie after the completion of the Oklahoma City-El Reno interurban, now in course of construction.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

LIBERTYVILLE, IOWA.—The foundation is being laid for a telephone building. C.

CROSBY, MINN.—The Aitkin-Deerwood Telephone Company has been granted a franchise here.

BISMARCK, N. D.—The North [illegible]a Independent Telephone Company is about to remodel its building. C.

WALWORTH, WIS.—The Walworth Telephone Company has been incorporated with a capital stock of $25,000.

CUBA, MO.—The Cuba & Oak Hill Telephone Company has been incorporated with a capital stock of $2,000.

GLENDALE, IOWA.—The Glendale Telephone Company has been incorporated with a capital stock of $2,700.

TRUMBULL, NEB.—The Farmers' Telephone Company will shortly commence the erection of a central office. C.

BEVERLY, NEB.—The Frenchman Valley Telephone Company has been incorporated with a capital stock of $1,000.

WALDRON, ARK.—The Citizens' Telephone Company recently completed the installation of its apparatus in this city.

BATAVIA, O.—An exchange will be built here by the Cincinnati Bell Telephone Company at an expense of about $8,000.

NEWPORT, OKLA.—The Lone Grove & Woodford Telephone Company has been incorporated with a capital stock of $1,500.

LEBANON, TENN.—The Lebanon Home Telephone, which was organized here with a capital of $15,000, will install a local system.

NEW ENGLAND, N. D.—The North Dakota Independent Telephone Company has completed arrangements for the installation of an exchange. C.

WICHITA, KANS.—The telephone lines of the Missouri & Kansas Telephone Company are being placed underground in the down town districts in compliance with a recent ordinance.

ODIN, ILL.—The Odin Telephone Exchange has been incorporated with a capital stock of $15,000 to do a general telephone business. The incorporators are James N. Dace, Horace N. Woodward, Charles E. Sloan, Lafayette Somerville and W. H. Farthing. Z.

BOISE, IDAHO.—The merger of the Bell and Independent Telephone Companies, operating in Ada, Canyon and Boise Counties, will be completed June 26, at which time the Independent Company will take over the operation of the lines, according to a statement made by an official. While the business management of the companies will be under one head after July 1, the business will not be operated from one building until September 1.

ELECTRICAL SECURITIES.

Transactions in stock, while smaller than those of the previous week, showed firmness. Dealings in bonds were more than one-fifth greater, with a trend generally upward. The monthly statement of the Copper Producers' Association shows that consumption of refined copper by American users increased 12,000,000 pounds in May over April, indicative of increased activity in production of electrical equipment and brass manufacturing. Deliveries for export were about the same as reported for the previous month.

At the annual meeting of the Mexican Telegraph Company, and Central & South American Telegraph Company, retiring directors were re-elected.

There has been listed on the Philadelphia Stock Exchange $707,900 additional preferred and $221,300 additional common stock of the National Gas, Electric Light & Power Company.

The Lynchburg Traction & Light Company of Virginia, a subsidiary of the American Railways Company, has filed a mortgage to secure an issue of $1,750,000 twenty-year five per cent bonds. The proceeds will be utilized to retire outstanding bonds and for improvements and extensions.

An advance offering of the new $30,000,000 Chicago Elevated Railways three-year five-per-cent notes is being made at ninety-eight and one-half and interest, to yield better than five and one-half per cent. The notes will be secured by $25,000,000 new first mortgage thirty-year five-per-cent bonds of the Northwestern Elevated Railroad and by stocks of various properties acquired under the plan at a total cost of over $21,000,000. This issue was recently purchased by the National City Bank of New York.

DIVIDENDS.

Cincinnati Gas & Electric Company, quarterly dividend of one per cent, payable July 1.

Cincinnati Street Railway Company, quarterly dividend of one and one-half per cent, payable July 1.

Cumberland Telephone & Telegraph Company, quarterly dividend of two per cent, payable July 1.

Interborough Rapid Transit Company, quarterly dividend of two and a quarter per cent, payable July 1.

Manila Electric Railroad & Lighting Company, quarterly dividend of one and a quarter per cent, payable July 1.

National Gas, Electric Light & Power Company, regular quarterly dividend of one and one-half per cent on preferred stock, payable July 1 to stock of record June 14.

New York Edison Company, quarterly dividend of one and one-half per cent, payable June 14.

St. Joseph Railway, Light, Heat & Power Company, regular quarterly dividend of one and one-quarter per cent on the preferred stock, payable July 1 to stock of record June 15.

Texas Traction Company, quarterly preferred dividend of one and one-half per cent, payable July 15.

Twin City Rapid Transit Company, common quarterly dividend of one and one-half per cent, and preferred of one and three-quarters per cent, both payable July 1.

United Traction & Electric Company, regular quarterly divident of one and one-quarter on its capital stock, payable July 1, 1911.

Union Traction Company (Philadelphia), semi-annual dividend of three per cent, payable July 1.

Virginia Railway & Power Company, regular semiannual dividend of two and one-half per cent on the preferred stock, payable July 10 to stock of record June 30.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	June 12.	June 5.
Allis-Chalmers common	8¾	9¼
Allis-Chalmers preferred	32	32
Amalgamated Copper	68⅛	67
American Tel. & Cable	*80¼	80¼
American Tel. & Tel.	152	149⅝
Brooklyn Rapid Transit	81¼	80¾
General Electric	163½	163½
Interurban-Metropolitan common	19⅛	19
Interborough-Metropolitan preferred	52½	52⅛
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	91	89½
Mackay Companies (Postal Telegraph and Cables) preferred	74⅛	75¼
Manhattan Elevated	139	137
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	51	50⅜
U. S. Steel common	77⅞	78⅛
U. S. Steel preferred	118⅛	119
Western Union	82¼	81½
Westinghouse common	76½	75
Westinghouse preferred	110	113

*Last price quoted.

BOSTON.

	June 12.	June 5.
American Tel. & Tel.	152	149¾
Edison Elec. Illuminating	286	286
General Electric	163½	164
Massachusetts Electric common	23¼	23¾
Massachusetts Electric preferred (ex-dividend)	90	92½
New England Telephone	150½	146½
Western Tel. & Tel. common	19	19½
Western Tel. & Tel. preferred	95	94

PHILADELPHIA.

	June 12.	June 5.
American Railways	44	44
Electric Company of America	11⅞	12
Electric Storage Battery common	55	54½
Electric Storage Battery preferred	55	54½
Philadelphia Electric	17	16½
Philadelphia Rapid Transit	20	18
Philadelphia Traction	87	82½
Union Traction	49¼	46

CHICAGO.

	June 12.	June 5.
Chicago Railways, Series 1	80	80
Chicago Railways, Series 2	21½	21½
Chicago Subway	4	4
Chicago Telephone	122	123
Commonwealth Edison	128	128½
Metropolitan Elevated common	24½	27
Metropolitan Elevated preferred	71	72¼

PERSONAL MENTION.

M. J. KEHOE, for six years general manager of light and power for the Ft. Wayne & Northern Indiana Traction Company, has resigned, to go into other business. His sucessor has not been named.

GEORGE R. FULLER, president of the Rochester Telephone Company of Rochester, N. Y., has been elected vice-president of the Rochester, Syracuse & Utica Telephone Company which was recently reorganized.

R. A. CARLE, erecting engineer of the Westinghouse Electric & Manufacturing Company in the Baltimore district, has accepted a position with the Capital Traction Company, of Washington, D. C. He will be concerned with the construction of a new central station there.

O. B. COLDWELL, electrical engineer of the Portland Railway, Light & Power Company, Portland, Ore., has been elected first vice-president of the Oregon Society of Engineers. This society was recently organized in Portland, and had a charter membership of 160.

N. A. KEMMISH has resigned as electrical engineer of the Lincoln (Neb.) Traction Company, to become general manager of the municipal electric lighting and pumping station at Alliance, Neb. Mr. Kemmish has been with the Lincoln Traction Company for the past seven years.

ALLAN V. GARRATT, chief engineer of the Lombard Governor Company, of Ashland, Mass., was a conspicuous attendant at the National Electric Light Association convention at New York. Mr. Garratt was the first paid secretary of the National Electric Light Association, opening the first permanent office of the association at 39 Cortlandt Street, New York City, about 1887.

VLADIMIR KARAPETOFF, professor of electrical engineering in Cornell University, delivered an address before the local chapter of the Society of Sigma Xi at Worcester Polytechnic Institute on June 6. This was the fourth annual meeting of the chapter and was held in connection with the commencement exercises. The title of the address, to which the public was invited, was "Engineering Calculations of Electrostatic and Electro-magnetic Circuits."

HENRY W. CHASE, of Cincinnati, O., has been chosen head of the new-business department of the Binghamton Light, Heat & Power Company. Mr. Chase was early attracted by the possibilities of the lighting business and became a workman for the Binghamton Gas Company and later accepting a position in Cincinnati. For some time he was in charge of the sales department of the Union Gas & Electric Company of Cincinnati. Mr. Chase has been widely quoted on account of technical articles which he has written, and his name is well known in electrical circles.

JAMES B. OLSON, general sales manager of the Habirshaw Wire Company, who took a very active part in the entertainment and proceedings of the National Electric Light Association convention, is a friend of Cartoonist Long, of the New York *Daily World*. Mr. Long visited the convention and was introduced to a number of the officials by Mr. Olson, and afterwards presented a very amusing and interesting half-page cartoon of several of the officers and others, in the *Evening World*. Mr. Olson, W. W. Freeman, Arthur Williams, T. C. Martin, F. M. Tait, Dudley Farrand and others were the artistic subjects.

OBITUARY.

E. J. CLAPP, former assistant general manager of the Inter-State Independent Telephone & Telegraph Company with headquarters in Aurora, Ill., died suddenly June 2 at Newton, Ill. Mr. Clapp was for many years in Aurora with the telephone company but in 1906 went to Newton where he bought the telephone exchange. He sold this a year ago and returned to his old home at Warren, O. His death occurred on a business trip to Newton.

WILLIAM RICHARD BRIXEY died at Milford, Conn., June 9, 1911. The interment was at Seymour, Conn. Mr. Brixey was a well known manufacturer in that state, with business headquarters in New York City. He was born in Southampton, Hampshire County, England, May 11, 1851. He became a citizen of the United States in 1879. Mr. Day, a pioneer in the rubber industry in this country and the inventor of Kerite, was his brother-in-law and early associated Mr. Brixey with him in the manufacture of Kerite insulated wires and cables. In 1879 Mr. Brixey married Nancy DeWolfe of Seymour. In 1908 Mr. Brixey incorporated his business under the name of the Kerite Insulated Wire and Cable Company. He leaves three sons. He was for many years captain in the Old Guard of New York City, and was a thirty-second degree Mason. He was also a member of the American Institute of Electrical Engineers.

NEW PUBLICATIONS.

MAGNETIC PROPERTIES OF HEUSLER ALLOYS.—A bulletin under this title by Edward B. Stephenson has just been issued as Bulletin No. 47 of the engineering experiment station of the University of Illinois. This bulletin is a contribution of data on the subject of magnetic alloys, and describes fully the methods of magnetic testing, thermal analysis and photo-micrography used in the work.

REPORT OF MASSACHUSETTS COMMISSION.—The twenty-sixth annual report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts has been issued. It covers the calendar year 1910, with tables from the annual returns for the year ending June 30, 1910. It includes the rates, dividends and taxes of the electric lighting companies, the legislation recommended, meters tested, etc.

THE ARC LIGHT AND X-RAY TUBES.—An experimental lecture by Hermann T. Simon, professor of applied electricity at Göttingen, on the arc light has been published in pamphlet form by the firm of S. Hirzel, in Leipsig, Germany. It forms a very instructive pamphlet, containing many curves and other illustrations, including a reproduction of a typical arc in colors. The same firm has also published a pamphlet by Alfred Wertheimer on current and voltage curves in Roentgen-ray tubes. It gives the operating characteristics under different conditions of discharge. The price of each pamphlet is two marks.

THE SPONTANEOUS COMBUSTION OF COAL WITH SPECIAL REFERENCE TO BITUMINOUS COALS OF THE ILLINOIS TYPE.—This publication has just been issued as Bulletin No. 46 of the engineering experiment station of the University of Illinois. The bulletin describes a series of experiments directed toward the determination of the fundamental causes underlying the spontaneous combustion of coal. These causes may be summarized as follows: (1) external sources of heat, such as contact with steam pipes, hot walls, and the impact of large masses in the process of unloading, height of the piles, etc.; (2) fineness of division; (3) moisture; (4) activity of oxidizable compounds, such as iron pyrites.

PROPOSALS.

POCOHANTUS, IOWA.—Geo. Schnieders, city clerk, will receive bids up to June 27 for installation of a complete electric light plant. The Oscar Claussen Engineering Company, of St. Paul, will act as consulting engineer. C.

POST OFFICE, CORDELE, GA.—The office of the Supervising Architect will receive sealed bids until July 15 for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures) of the United States Post Office at Cordele, Ga., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Cordele, or at the Supervising Architect's office.

POST OFFICE, SUFFOLK, VA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until June 28 for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the United States post office at Suffolk, Va., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Suffolk, or at the Supervising Architect's office.

POST OFFICE, WINCHESTER, KY.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until July 15 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures) of the United States Post Office at Winchester, Ky., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Winchester, Ky., or at the Supervising Architect's office.

NEW INCORPORATIONS.

SCOTTS BLUFF, NEB.—The C. & R. Electric Company has been chartered with a capital stock of $25,000.

MILWAUKEE, WIS.—The American Electric Company has been incorporated with a capital stock of $6,000.

KANSAS CITY, MO.—The Electric Machinery & Wiring Company has recently incorporated with a captal of $9,000. The incorporators are T. B. Stuszer, John H. Shaw and Theodore Remley, all of Kansas City.

CLEVELAND, O.—The Cleveland Electric & Manufacturing Company has been incorporated with a capital stock of $25,000 by Auolph F. Klein, August H. Bender, Ben Taulb, Alonzo Manhard and S. J. Schwenger.

LOUISVILLE, TENN.—The Multiple Sign Company has incorporated wit a capital of $10,000 to manufacture changeable electric signs. The incorporators are A. C. Bowen, John C. Hughes, George T. Wood, William C. Kentrick and J. J. Roberts.

INDUSTRIAL ITEMS.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., is advertising the Millar electric toaster by means of a recently distributed circular.

THE SUNRAY ELECTRIC LAMP MANUFACTURING COMPANY, New York, N. Y., announce its removel from No. 109 West orty-second Street to 311 West Fifty-ninth Street.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., describes in the June issue of *"Trumbull Cheer"* its boxes and cabinets together with other specialties.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., recently issued pamphlets on electrically heating appliance and also on ignition apparatus and accessories.

PAGE & HILL COMPANY, dealers in cedar posts and poles, Minneapolis, Minn.,, has installed an electric lighting system at its Minnesota Transfer yard, in order to permit of night work.

THE WESTERN ELECTRIC COMPANY, New York, N. Y., has prepared a bulletin dealing with railroad telephone and selective apparatus. Parts are listed and illustrated and prices are given throughout.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., describes the "Minimax" garage pump in the June issue of *The Emerson Monthly*. Among other things an exhaust fan for moving-picture theaters is illustrated and described.

THE LORD MANUFACTURING COMPANY, New York, N. Y., announces that owing to the great growth of its business and the increasing number of American and foreign shipments, it has been compelled to install additional machinery.

THE DETROIT FUSE & MANUFACTURING COMPANY, Detroit, Mich., is distributing Bulletin No. 21 on "Detroit" switches and Bulletin No. 22 on "Arkless" fuses. These bulletins give complete prices and information on these lines.

ALLEGEMEINE ELEKTRICITÄTS-GESELLSCHAFT, Berlin, Germany, has published a pamphlet describing mercury rectifiers for use with moving-picture machines. The relative costs of different sources of current for this purpose are given.

THE FORT WAYNE ELECTRIC WORKS, Ft. Wayne, Ind., has announced its affiliation with the General Electric Company, of Schenectady, N. Y. Business will in the future be conducted under the name "Fort Wayne Electric Works of General Electric Company."

THE H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., is marketing a product known as Solderall which is put up in a collapsible tube and can easily be applied to a joint to be soldered. Its convenience, cleanliness and economy have made it popular with electricians.

THE EASTERN ELECTRIC LAMP COMPANY has, owing to an increase of business, found it necesssary to move its executive offices to the Oliver building at 141 Milk Street, Boston, Mass. The new quarters are more commodious than those formerly occupied by the company.

THE LOMBARD GOVERNOR COMPANY, Ashland, Mass., announces a reduction in the price of its medium-sized hydraulic governors, due to the decision of the company to manufacture the types F, M, P and O in large quantities. This adoption of the lower price went into effect March 1.

THE CROWN ELECTRICAL MANUFACTURING COMPANY of St. Charles, Ill., will open a branch in the Burton Building, Broadway, Aurora, Ill., with Charles E. Wallace as manager. This will be a show room for fixtures and all sorts of electric light and other electrical supplies. Contracting work also will be done.

H. C. BOWLUS MANUFACTURING COMPANY, Springfield, O., distributed folders recently, advertising the Bowlus chain-drive boring machine for electricians. The folder calls attention to the complete line of electrician's boring tools carried by the company, showing illustrations of some of these tools in operation.

PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., describes its plant and equipment quite fully in a recently published bulletin. Illustrations of the machine shops, foundries and yards, together with a number of cranes manufactured at the works, are shown, and a considerable amount of descriptive matter is included.

UNITED STATES ELECTRIC COMPANY, New York, N. Y., recently distributed bulletin No. 702 on the subject of "Absolute Safety by Selective Signaling." The growth of the practice of signaling is taken up and its application to interurban roads dealt with. The latest type of signals are illustrated and shown by diagrams.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., makes the announcement that through a license agreement with the Westinghouse Electric & Manufacturing Company it has been permitted to make and sell induction meters, utilizing the Shallenberger method of compensation for inductive load, as covered by patents of January 1, 1895, and October 22, 1895.

THE DUPLEX METALS COMPANY, Chester, Pa., advertises its four grades of copper-clad steel wire in a recent folder. These are the forty-seven per cent grade with a conductivity of forty-four to fifty per cent; the forty per cent grade with a conductivity of thirty-five to forty-five per cent, and the thirty per cent grade with a conductivity of twenty-five to thirty-five per cent.

THE AMERICAN SHIP WINDLASS COMPANY, Providence, R. I., announces that it has sold an aggregate of 22,700 horsepower of Taylor stokers. Those ordering the stokers were Havana Electric Railway Company, Dayton Citizens Electric Light Company, New York, New Haven & Hartford Railroad Company (Cos-Cob station), Northern Ohio Traction Company and the Philadelphia Electric Company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., analyzes in a recently issued folder the underlying principles of transformer design. Especial attention is called to the fact that it is necessary in transformer design to secure some qualifications stronger than a mere guarantee of long life. A reduction of the energy wasted amounts to a replacement of loss with net profits. The exact causes of these losses are outlined in the publication.

THE STONE & WEBSTER ENGINEERING CORPORATION, Boston, Mass., has incorporated into a bulletin a number of illustrations of two large reinforced concrete buildings which were designed and erected for the General Electric Company. Both of these buildings were constructed in record time, building No. 46, the most recent, being started on August 2 and completed September 24. The frame with floors comprised 6,100 yards.

THE BRILLIANT ELECTRIC COMPANY, Electric Building, Cleveland, O., is distributing a twelve-page price list of vest-pocket size, covering the principal types of Brilliant incandescent lamps, including the new drawn-wire "Mazda." A commendable feature of the booklet is its stiff cover, which is calculated to preserve the contents until the owner has thoroughly familiarized himself therewith, or until such time as a later edition may be issued.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., recently distributed bulletin No. 39 on the subject of "Elba Electric Lighting Batteries for Automobiles." With the installation of reliable batteries and electric headlights the pleasure of driving at night is materially increased. In the bulletin a full explanation of the construction of the Elba lighting batteries is given, several illustrations serving to make the descriptive matter clear. A table of capacity is included.

THE CENTRAL STATION HEATING & CONSTRUCTION COMPANY, 714 Ellicott Square, Buffalo, N. Y., has been incorporated in the state of New York to carry on a construction and engineering business, specializing particularly in central-station heating plants. J. A. Bendure, well known as a consulting engineer,

and E. M. Bendure, public-utility expert, are president and secretary respectively. W. G. Dargan and G. L. Corliss, also prominent in the industry, constitute the other members of the staff.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, O., has moved its Chicago headquarters, which were formerly in the Merchants' Loan Trust Building, to 1417 Monadnock Block. The business in the Chicago territory, under the direction of William M. Connelly, district manager, will hereafter be carried on from this office. Coincident with this is the announcement that T. H. Pither, formerly with the Western Electric Company, has been added to the sales force of the company.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., announces the opening of a new store room at Atlanta, Ga. The development of the electric-vehicle business in the South, and the constantly increasing shipments of "Exide" batteries to that section have necessitated this addition to the company's equipment of store rooms and depots. A supply of "Exide" material will now be kept in stock at Atlanta for the purpose of promptly supplying the requirements of agents and owners of electrics in that territory.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., distributed at the National Electric Light Association Convention, recently held in New York, a booklet on Cutler-Hammer control in New York. A number of New York's largest buildings which are equipped with Cutler-Hammer control are illustrated. A statement is made in the booklet that a list of office buildings in which Cutler-Hammer control is used would be equivalent to a building directory of New York City. A map of New York City for the convenience of delegates attending the convention was inserted in the booklet.

THE AMERICAN DISTRICT STEAM COMPANY, North Tonowanda, N. Y., calls attention in a pamphlet entitled "Central Station Heating," to the work which is being done in combining the operation of an electric light and power plant in the central station system of underground mains for the distribution of exhaust steam for heating purposes. The pamphlet is attractively prepared and contains a number of photographs of buildings in progressive cities in the United States which are heated with systems installed by the American District Steam Company. There are also illustrated points of mechanical interest and construction.

DATES AHEAD.

National Electrical Contractors' Association. Niagara Falls, N. Y., June 19.

Michigan Electric Association. Annual convention, on board steamer *Minnesota*, leaving Grand Haven, Mich., June 19, returning to St. Joseph, Mich., June 22.

National Gas and Gasoline Engine Trades Association. Convention, Detroit, Mich., June 19-23.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

Mississippi Electric Association. Annual meeting, Gulfport, Miss., June 20-22.

Canadian Electrical Association. Annual convention. Niagara Falls, Ont., June 21-23.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

American Institute of Electrical Engineers. Annual convention, Chicago, Ill., June 26-30.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass., June 26-30.

American Chemical Society. Annual meeting, Indianapolis, Ind., June 28-30.

American Society for Testing Materials. Annual meeting, Atlantic City, N. J., June 27 to July 1.

National Electrical Contractors' Association. Niagara Falls, N. Y., July 19.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 25-28.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, LaSalle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) June 6, 1911.

994,109. ELECTRICALLY-OPERATED SIFTER. John F. Beck and William Lindsay, Chicago, Ill., assignors to L. Wolff Manufacturing Co., Chicago, Ill. Filed Aug. 28, 1907. An electric motor with vertical shaft is arranged at one side of a sieve and operates the latter through an electric vibrator.

994,114. MECHANICAL MOVEMENT. Tonjes August Carl Both, New York, N. Y., assignor to Ida S. Rosenheim, New York, N. Y. Original application filed July 2, 1910. Divided and this application filed Oct. 11, 1910. Relates to a driving mechanism for turning the key of a lamp socket on and off.

994,125. RAILWAY-SIGNAL. John P. Coleman, New York, N. Y., assignor to Union Switch & Signal Co., Swissvale, Pa. Filed May 2, 1910. An electromagnet is arranged to connect a semaphore signal with a driving motor.

994,145 and 994,146. AUTOMATIC ELECTRIC-LIGHTING SYSTEM. John W. Frees and Louis Winter, Reading, Pa. Filed May 2, 1910. Includes an internal-combustion engine driving a generator, a storage battery and electromagnetic means for starting the engine when the battery voltage reaches a definite low point or when the current gets above a certain value and for stopping the engine when the battery voltage reaches a definite high point.

994,159. MOTOR-CONTROLLER. Clark T. Henderson, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed Oct. 17, 1908. A regenerative controller for a series motor has a relay for connecting the field for separate excitation and for disconnecting it when the armature begins to generate current.

994,170. AUTOMATIC CIRCUIT-CLOSER. Leander A. Laplant, Plattsburg, N. Y. Filed April 8, 1910. Includes oppositely acting toggle links and an electromagnet for actuating one set to close the switch and the other to open it.

994,188. ELECTRIC HEATING UNIT. Edward J. Ovington, Los Angeles, Cal., assignor to Electric Device Co. Filed Jan. 25, 1909. An immersion heater comprises a conical metal shell, interior insulation for the shell, a conical resistance core tightly pressed into the shell and a cap tightly pressed against the core, the end of the shell being spun over the cap to hold the core in place.

994,203. BERTH-LAMP. Max M. Schneider, Chicago, Ill., assignor to Pullman Co., Chicago, Ill. Filed Nov. 14, 1910. Is provided with a reflector secured to the rear side of a front plate. The latter supports an incandescent-lamp socket and has a cover partly closing the opening in the plates.

994,205. ELECTRIC INCUBATOR. Edwin H. Schorer, Columbia, Mo. Filed Sept. 13, 1909. An electric radiator in a chamber is controlled by thermally separable contacts.

994,212. UNIFORM-MOVEMENT DEVICE. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed Oct. 2, 1907. An elevator controller is moved vertically over its contacts with uniform speed by the plunger of a solenoid which is retarded more and more as it enters the coil.

994,217. ELECTRIC FURNACE. John Thomson, New York, N. Y., assignor to Imbert Process Co., New York, N. Y. Filed Sept. 1, 1909. Has an incased resistor which is adapted to be immersed in a molten bath the resistor being formed of a number of interlocking members.

994,218. ELECTRIC SIGNALING APPARATUS. Samuel P. Thrasher, Hartford, Conn. Filed June 3, 1909. A system for signaling from the pilot house to the engine room of a ship includes a duplicate receiver and transmitter in each with a full set of electric lamp signals and corresponding jacks. The engine-room equipment also has an electric bell which rings till the engineer signals back that he understood the signal.

994,228. ELECTRIC-LIGHT-BULB SHADE. Benjamin Robertson Williams, English, Ark. Filed March 14, 1911. An incandescent lamp is surrounded by two oval-shaped shades each having an opening in its side and the outer shade being rotatable to bring the opening in line.

994,251. COMBINED FUSE-BOX AND SWITCH FOR ELECTRIC CIRCUITS. Paul Druseidt, Remscheid, Germany. Filed Sept. 7, 1910. Includes a cartridge fuse mounted adjacent the spindle of a rotary switch, both being inclosed.

994,259. HAIR-DRIER. Gabriel M. Kazanjian, Chicago, Ill., assignor to Eldridge L. Messer, Chicago, Ill. Filed Nov. 20, 1908. Mounted in a casing is a hand-operated rotary fan forcing air through a spout containing an electric heater.

994,261. ARC-LAMP. Max Korting, Leutzsch, near Leipzig, Germany, assignor to Korting & Mathiesen Aktiengesellschaft, Leutzsch, near Leipzig, Germany. Filed Jan. 26, 1911. A direct-current flaming-arc lamp has rough depositing surfaces forming a cylinder around the upper (positive) electrode and charged positively on one wall and negatively on the other.

994,288. IGNITION SYSTEM FOR GAS-ENGINE DYNAMO SETS. Egmont Max Tormin, Newton Center, Mass., assignor to Holtzer-Cabot Electric Co., Brookline, Mass. Filed March 29, 1910. The spark-producing apparatus comprises a spark plug, a timer,

a shaft driven by the engine for driving the timer, a protective resistance connected in the circuit between the spark plug and timer, and a member inclosing the resistance and serving as a coupling between the timer and shaft.

994,291, 994,292 and 994,293. PORTABLE-ELECTRIC-LIGHT FIXTURE. Leroy A. Williamson, Boston, Mass., assignor to L. A. Williamson Co., New York, N. Y. Filed Oct. 13, 110. These three patents cover various forms of a casing in which, or upon which, lamp cord is wound, one end of the cord having an attachment plug and the other being connected to a lamp socket that can be disposed in the center of the casing.

994,294. OZONE-GENERATOR. Eugene P. Woillard, Los Angeles, Cal. Filed Oct. 17, 1910. A terminal plate comprises a base of an electrical conductor, and a facing of porcelain enamel for the base bonded thereto and completely covering the same.

994,300. ELECTRICAL VIBRATOR. Herman I. Blattle and Paul Newman, Providence, R. I. Filed Oct. 3, 1910. Comprises a metal shell inclosing the actuating mechanism, and provided with an aperture, a vibrator operating through the shell aperture, a magnet for actuating the vibrator and including a secondary winding, connections including the vibrator for applying secondary current to the skin, and controlling means carried on the casing for varying the length of the secondary winding to vary the intensity of the current applied to the skin.

994,302. TELEPHONE SYSTEM. Henry P. Clausen, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Co., Rochester, N. Y. Filed April 26, 1901. Relates to means for connecting ordinary physical telephone lines to phantom lines, a set of repeating coils being connected in the latter case.

994,303. ARMATURE. Stanley A. Duvall, San Francisco, Cal., assignor to John S. Nash, Chicago, Ill. Filed March 14, 1910. Cylindrically shaped pole pieces are secured to a central core and the winding is placed around the latter, after which the pole tips are joined by non-magnetic bridges.

994,304. MAGNETO. Stanley A. Duvall, Los Angeles, Cal., assignor to John S. Nash, Chicago, Ill. Filed April 27, 1910. Has a field distributer with an opening arranged to be covered by a closure.

994,329. PHOTOMETER. Daniel McFarlan Moore, Newark, N. J., assignor to Moore Electrical Co., New York, N. Y. Filed April 7, 1906. A portable photometer box, one end of which is provided with a transverse opening extending across from side to side and adapted to receive and fit around a section of electric light tube.

994,345. CURRENT-CONTROLLING APPARATUS. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed June 12, 1905. An automatic starter for an elevator motor is operated by a series and a shunt electromagnet for gradually short-circuiting the starting resistance.

994,355. RESISTANCE UNIT AND METHOD OF MAKING THE SAME. Charles Wirt, Philadelphia, Pa., assignor, to Wirt Electric Specialty Co. Filed June 27, 1906. Has a helical resistance coil, a skeleton frame of insulating material upon which the coil is wound, and a body of molded plastic insulating material in which the coil and its frame are imbedded.

994,361. METHOD OF PROPAGATING TELEPHONIC CURRENTS. Charles G. Ashley, Chicago, Ill. Filed July 24, 1909. A means for intensifying telephone currents includes a generator with a field energized by the pressure of the line to be strengthened and an inductor affected thereby and connected in series with the line.

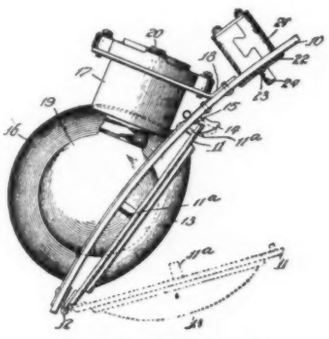
994,371. INDIVIDUAL SELECTIVE LOCK-OUT DEVICE FOR PARTY-LINE TELEPHONE SYSTEMS. William M. Bruce, Jr., Springfield, Ohio, assignor to American Automatic Telephone Co., Rochester, N. Y. Filed Sept. 1, 1904. Includes a vertically-moving cylindrical step-up rod having circumferential notches, a step-up magnet and pawl pivoted to the armature of the magnet to engage the notches, a telephone circuit normally closed to line by means controlled by the rod, a selector magnet and a circuit therefor including an adjustable circuit closer, and circular contact element on ahe step-up rod to engage the circuit closer to close the circuit of the selector magnet and means for successively energizing the step-up magnet.

994,375. AUTOMATIC CIRCUIT-CLOSING DEVICE. Walter A. Collins, Mount Vernon, N. Y. Filed June 11, 1909. A pair of fusible plugs hold a contact member which is adapted to close an alarm circuit on the fusing of the plugs.

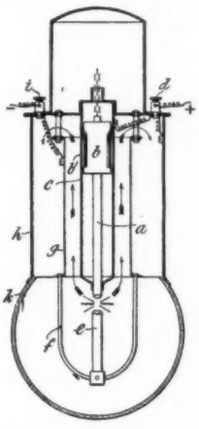
994,381. ALTERNATING-CURRENT MOTOR. Valere Alfred Fynn, London, England. Filed Nov. 19, 1909. A rotor provided with a commuted winding and a squirrel-cage winding, a bridge of magnetic material separating the windings, and means for permitting a current to flow around at least part of the bridge.

994,382. ALTERNATING-CURRENT MOTOR. Valere Alfred Fynn, London, England. Filed Nov. 29, 1909. Combined with a stator provided with a distributed inducing winding connected to the mains, is a rotor with means for closing the rotor winding along at least two axes and means for changing the point of connection of only one of the mains to the distributed stator winding without changing its number of active turns.

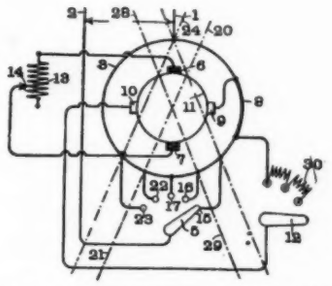
994,405. ELECTRICAL ARRANGEMENT FOR PROTECTING SHIPS' BOTTOMS FROM BARNACLES OR AQUATIC LIFE AND SUCH LIKE. John Evans James, Bolton, England. Filed May 3, 1910. The secondary windings of induction coils are connected to discharge points in the sides of the ship but insulated therefrom at one terminal.



994,203.—BERTH LAMP.



994,261.—FLAMING-ARC LAMP.



994,382.—ALTERNATING-CURRENT MOTOR.

994,425. METHOD OF ANCHORING FILAMENTS. Hermann Remane, Berlin, Germany, assignor to General Electric Co. Filed June 27, 1906. A movable open guide piece is placed at the side of the filament, the filament then being passed through the guide piece, and the guide turned so that it stands transversely to the filament.

994,426. RECEIVER FOR WIRELESS TELEGRAPHY. Ragnar Hakan Rendahl, Berlin, Germany, assignor to Gesellschaft für Drathlose Telegraphie. Berlin, Germany. Filed Nov. 1, 1906. Comprises an oscillating circuit, containing a self-induction coil, an aperiodic circuit branched off from the self induction coil, a detector responding to current intensities, a condenser included in the aperiodic circuit and an indicator parallel to the condenser.

994,427. ELECTRIC ARC LAMP. Oscar A. Ross, Chicago, Ill., assignor to Albert H. Meads, Chicago, Ill. Filed Feb. 9, 1903. The lamp is inclosed in a glass cover supported by a hinged ring. The hinge is attached to the stationary part of the inclosing casing through a spring which permits of some play.

994,447. ELECTRIC RADIATORY STOVE. Georg Egly, Treptow, near Berlin, Germany. Assignor to Gebrueder Siemens & Co., Berlin, Germany. Filed Oct. 27, 1910. A heating rod is inclosed in a non-metallic tube of considerably greater diameter.

994,451. PROCESS OF MAKING SECONDARY-BATTERY PLATES. John E. Frederickson, Revere, Mass. Filed Jan. 21, 1909. Tetroxide of lead is mixed with a sodium-carbonate solution to form a paste. After the paste is applied to the plate it is placed in a sodium-carbonate bath and current passed through it.

994,474. MEANS FOR INSULATING CANOPIES FOR SYSTEMS OF ELECTRICAL DISTRIBUTION. George A. Lutz, Plainfield, N. J. Filed Feb. 20, 1909. The combination of opposed con-

duits and a canopy, with insulating blocks hung upon the conduits and spaced apart, said blocks receiving the canopy between them.

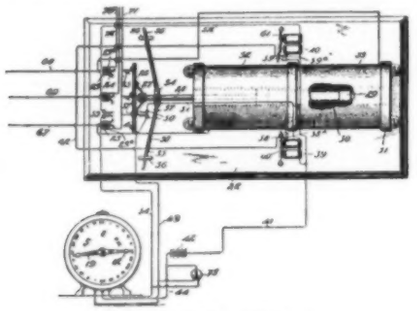
994,480. COMMUTATOR. Frederick W. Reeves, Pittsburg, Pa. Filed Dec. 4, 1909. Each of a number of insulated segments has a number of transverse grooves cut in its face.

994,493. PUSH-BUTTON. Forrest E. Altemus, Philadelphia, Pa. Filed Feb. 26, 1909. The movement of the button is completed by means of springs which actuate the contacts.

994,499. LAMP. Winfred G. Bowen, Detroit, Mich. Filed Dec. 10, 1910. A deck through which the support extends is provided with a cup into which the lamp may be lowered. When lowered the top of the lamp forms a closure for the cup.

994,500. SELECTIVE SYSTEM FOR PARTY-LINE TELEPHONES. William M. Bruce, Jr., Springfield, Ohio, assignor to American Automatic Telephone Co., Rochester N. Y. Filed June 9, 1905. A step-up rod has a series of steps and a holding pawl engaging in the steps to hold it in any desired position, a step-up magnet and its armature carrying a pawl adapted at each impulse to move the rod one step, a selector magnet having an armature, and a circuit closing device operated thereby.

994,510. ELECTRIC CAR-LIGHTING SYSTEM. Hugo Grob, Zurich, Switzerland. Filed April 29, 1907. Comprises a continuous current generator having two pairs of terminals, one of which has a lower voltage than the other; an extraneous source of constant voltage connected in parallel with the low-tension terminals of the generator; a storage battery connected in parallel with the high tension terminals of the generator; a storage battery connected in parallel with the high tension terminals of the generator; and an exciting coil adapted to



994,575.—TIME SWITCH.

influence the magnitude of the pressure produced in the generator and inserted into the circuit connecting the low-tension terminals of the generator with the source of constant voltage.

994,516. REVERSE ATTACHMENT-PLUG. Harvey Hubbell, Bridgeport, Conn. Filed Feb. 25, 1910. The contact member comprises a base of insulating material having a recess therein, a sheet of relatively stronger insulating material fitting within the recess, means for securing this sheet to the base, spaced contacts rigidly secured to the sheet, and a cap constructed to cover the base.

994,517. SEPARABLE ATTACHMENT-PLUG. Harvey Hubbell, Bridgeport, Conn. Filed April 23, 1910. The inside of the plug has a circular groove with which locking springs engage. An insulating block carries a contact plate which engages the contact springs.

994,518. PULL SOCKET. Harvey Hubbell, Bridgeport, Conn. Filed July 21, 1910. A rotating contact plate is returned to its original position after each operation.

994,542. ALARM-LOCK. Morris Sheinman, New York, N. Y. Filed Sept. 29, 1908. A contact bar actuated by the key makes an electric contact, ringing a bell when the lock is unlocked.

994,566. FUSE. Roland P. Bernardini, Providence, R. I. Filed March 25, 1911. A cartridge-type fuse is provided with threaded-plug ends. The end of the plug is tapered, and when in position presses firmly against the end of the fuse wire.

994,575. TIME-CONTROLLED ELECTRIC SWITCH. Chauncey R. Dana, Santa Maria, Cal. Filed Feb. 13, 1911. An auxiliary battery circuit includes electromagnets which operate contacts closing the main circuit. Means are provided for closing the battery circuit at a predetermined time.

994,585. CIRCUIT-CONTROLLING APPARATUS FOR ELECTRIC GAS-BURNERS. Ernest A. Frary and Edward N. Frary, South Deerfield, Mass., assignors to Acetylene Construction Co., Hartford, Conn. Filed Nov. 30, 1909. Attached to wheels operated by clockwork are detents which arrest and free a member operated by a motor. The motor controls the operation of the gas burners.

994,588. PULL-SOCKET. Harvey Hubbell, Bridgeport, Conn. Filed July 21, 1910. Combines with an insulating block, a metallic cup socketed in the block, a spring in the cup, an insulating block resting on the spring and a center post seated in the insulating block.

994,605. ELECTRIC IRONING DEVICE. George A. Ricks, LaFayette, Ind. Filed Nov. 2, 1910. A bracket is mounted on the ironing board, a flexible conductor extending through it, thus avoiding slack conductor on the ironing board.

994,623. COMBINED MULTIPLE FUSE-BLOCK AND SWITCH. Per Enock Westerdahl, Seattle, Wash. Filed Dec. 1, 1910. A number of fuses are arranged around the periphery of a revolvible fuse block. A new fuse may be inserted by turning the block, and the block may also be made to act as a switch.

994,652. RAIL-BOND. William Noble and Dikran K. Dabaghian, Oakland, Cal., assignors to N. & D. Manufacturing Co. Filed Aug. 24, 1910. Has a hard head into which an attaching plug of relatively soft material is screwed.

994,670. MEANS FOR CONTROLLING THE SUPPLY OF GAS TO GAS-BURNERS AND FOR IGNITING THE SAME. Amedeo Giorgi, Florence, Italy. Filed Jan. 21, 1910. An electromagnet has a hollow core through which gas flows from the main burner. A vibratory member attracted by the magnet alternately opens and closes a circuit which produces a series of sparks, lighting the gas.

994,673. SPARK-PLUG. William Hagstrom, Emanuel Hagstrom and Gustaf Hagstrom, Lindsborg, Kans., assignors to Hagstrom Brothers Manufacturing Co. Lindsborg, Kans. Filed Nov. 24, 1909. A spark plug for gas or gasoline engines.

994,677. MEANS FOR INDICATING A SHIP'S DEVIATIONS FROM ITS COURSE. William Henry Hennah and Auguste Kerr Waitangi Rissel, Wellington, New Zealand. Filed Aug. 7, 1909. A mariner's compass in an electric circuit actuates relays, which through a train of gears cause a stylus to move over a recording sheet showing a permanent record of deviations in either direction.

994,678. MENS FOR RECORDING AND GAGING A SHIP'S DEVIATIONS FROM ITS COURSE. William Henry Hennah and Auguste Kerr Waitangi Rissel, Wellington, New Zealand. Filed Aug. 7, 1909. The magnets controlling the stylus-moving mechanism are proportionately varied in strength, in direct ratio to the deviation of the ship from its course. The degree and direction of deviation are thus recorded.

994,690. ELECTRIC INCANDESCENT LAMP. Hermann Remane, Berlin, Germany, assignor to General Electric Co. Original application filed June 27, 1900. Divided and this application filed May 8, 1908. Refractory arms with open loops hold the filament in position. Flexible guide pieces are also used for additional support.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the nited States Patent Office) that expired June 12, 1911:

521,160. DRIVING MECHANISM FOR ELECTRICAL ELEVATORS. Charles E. Geiger, Louisville, Ky.

521,168. THERMO-ELECTRIC BATTERY. Ernst W. Junger, Skara, Sweden.

521,188. MAGNETO-TELEPHONE. Alfred Stromberg and Andrew Carlson, Chicago, Ill.

521,220. ELECTRIC TELEPHONE. Wilton L. Richards, Malden, Mass.

521,238. BOND FOR ELECTRICAL CONDUCTORS. John Herr, Philadelphia, Pa.

521,260. ELECTRIC BATTERY. Fred Dubero and Peter Mohrdieck, San Francisco, Cal.

521,274. TELEPHONE-SWITCH. Joseph B. Smith, Manchester, N. H.

521,303. BUSY TEST FOR MULTIPLE SWITCHBOARDS. James A. Wotton, Atlanta, Ga.

521,322. INCANDESCENT-LAMP SOCKET. Luke R. Peck, St. John's, Mich.

521,325. TELEPHONE-TRANSMITTER. Joseph B. Smith, Manchester, N. H.

521,326. CONDUIT SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. Harry Alexander, New York, N. Y.

521,331. ELECTRIC APPARATUS FOR AUTOMATIC WEIGHING. Charles E. Buzby, Philadelphia, Pa.

521,362. ELECTRIC-ARC LIGHT FOR MAGIC LANTERNS. Charles Beseler, Jersey City, N. J.

521,394. APPARATUS FOR MEASURING AND RECORDING ELECTRIC CURRENTS. William Thomson, Glasgow, Scotland.

521,396. ELECTRIC CLOCK-WINDING MECHANISM. Adolph E. Vidal and Gaston Hervieu, London, England.

521,412. TRACK-CIRCUIT. Louis F. Johnson, Poughkeepsie, N. Y.

521,422. TELEPHONE-CALL RECORDER. William F. Smith, San Francisco, Cal.

521,423. AUTOMATIC ELECTROMAGNETIC CUT-OUT. Lucius T. Stanley, Brooklyn, N. Y.

521,434. DUPLEX ELECTRIC-ARC LAMP. George F. Edens and John B. Brewer, Xenia, Ohio.

521,435. AUTOMATIC ELECTRIC SIGNAL-LAMP. John R. Farmer, St. Louis, Mo.

521,436. SYSTEM OF ELECTRICAL DISTRIBUTION. Thomas J. Fay, New York, N. Y.